POWER PLANT ENGINEERING

Established Over 31 Years

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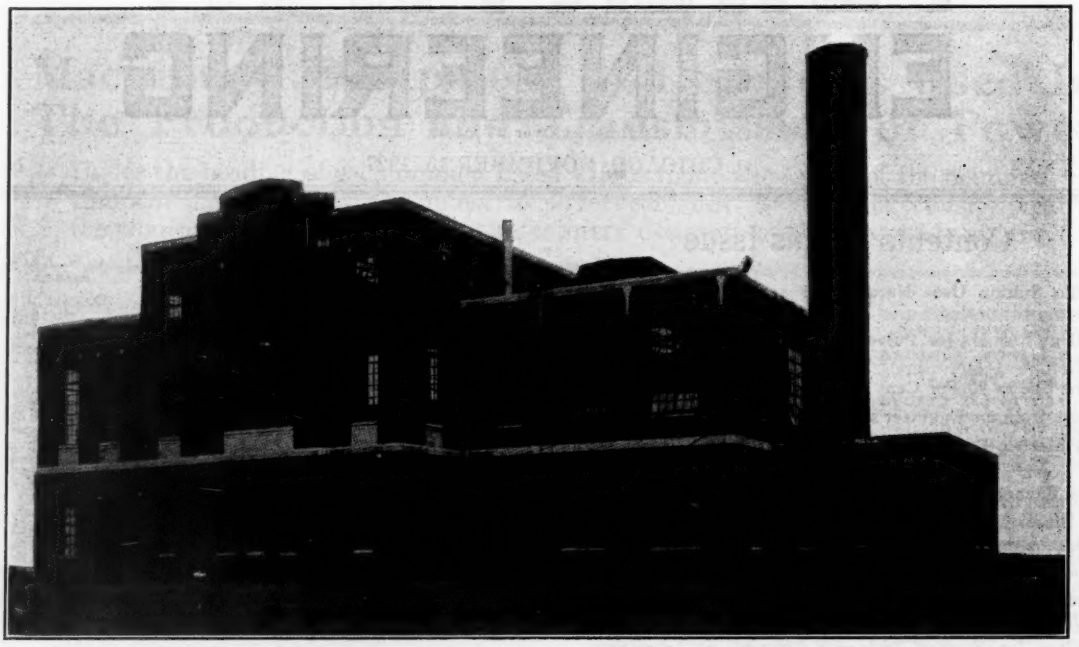
James Watt, Steam Engineer

MILLIONS OF YEARS ago a star out in the heavens sent forth a ray of light but that ray reached us only a short time ago. The twinkle we see now occurred before the human race came into being. Thus we find the eye actually seeing happenings before historical records were written.

Could we stand at the other end of time and envisage, as did James Watt, 150 yr. more of progress in the engineering field, we might see electric power made directly from the rays of the sun without the intervening ages of coal formation, sans coal piles, boilers and turbines. Then posterity will look bewildered at the complicated contraptions we call power plants and will wonder why James Watt, instead of some modern doctor of science hadn't harnessed direct sun power.

The present generation, however, feels sufficiently proud of its accomplishments that it is going to give posterity an opportunity to marvel, or perhaps smile or even laugh, at our frantic efforts to make machinery do our work for us, for a museum is actually being started which will deal with steam power plant engineering, more about which you will find on page 1199. James Watt gave a profession to men; does the vision of moderns compare with his? Let posterity answer.



Amarillo Station Uses Natural Gas as Fuel

STATION OF SOUTHWESTERN PUBLIC SERVICE CO. IN TEXAS PANHANDLE USES MODERN CONTROL EQUIPMENT, SPRAY POND COOLING AND SPECIAL GROUND. BY ALFRED IDDLES*

AMARILLO, A THRIVING city located in the middle of the Panhandle of Texas, has an advantageous location, being at the intersection of three important railroads, which has made the city the center of commerce and manufacture for the surrounding country.

Two years ago oil was struck in the Panhandle about 45 mi. from Amarillo and, since that time, one of the largest oil fields has been developed there. These have so boomed the city that the population grew in the last 2 yr. from 30,000 to 55,000, which increased the demand for light and power to such an extent that the Southwestern Public Service Co., which serves the city, found it necessary to increase its generating capacity.

The old plant, which had a total generating capacity of 4000 kw., was located near the center of the city and expansion at this location was impossible. Therefore, a new plant was decided upon and a site was chosen about 2 mi. from town, located on the Santa Fe and the Rock Island railroads, and conveniently situated for the installation of transmission lines to the city and to the towns of Panhandle and Pampa. These two towns were previously served by the same company from isolated stations with oil engine-driven generators.

OLD PLANT SERVES AS STANDBY

Since it was considered inadvisable at the time the plans for the plant were projected to install more than one turbine generator and since an adequate standby service is absolutely necessary for a public service company, it was decided to install a 5000-kw. unit in the new plant and to keep the old plant in readiness for standby service. This would enable the company to carry safely peak loads up to 5000 kw., and, the peak at the old plant at this time being only 3000 kw., it was considered that the new plant would take care of all load requirements up to 1930.

Designed for steam pressure of 260 lb. gage and a total steam temperature of 650 deg. F., the turbine is supplied with steam by two Stirling boilers each with 8340 sq. ft. of heating surface. Each boiler, when operated at 300 per cent rating, is capable of supplying all the steam required for the station but, ordinarily, both boilers are operated, since their efficiency is higher when they are not forced so much. When the capacity of the plant is doubled, only one additional boiler will be required, as two of the boilers will then carry the load, leaving the third boiler for standby service.

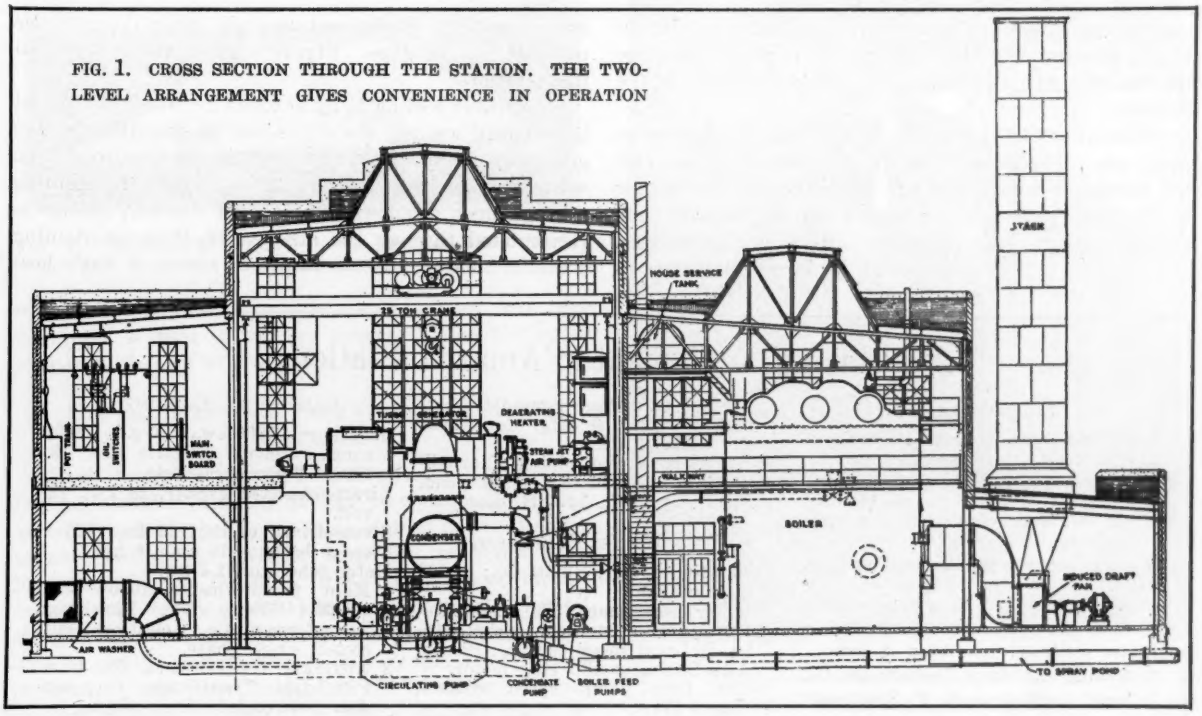
GAS PROVES ECONOMICAL AND CONVENIENT

Natural gas is found in large quantities in the oil fields of the Panhandle, the Amarillo Gas Co. conveying some of this at high pressure to Amarillo, where it is used as fuel for domestic and industrial purposes. The gas company has installed a 6-in. supply line to the new plant to furnish gas at 45 lb. pressure for the generation of steam. The gas burners utilize reduced pressures, depending on the load, up to a maximum of 15 lb. gage. Each boiler is supplied with seven gas burners, installed in the front wall of the furnace, which are capable of operating the boiler at 300 per cent rating.

Steam pressure is maintained by a hand-operated gas supply valve, the up-take damper controlling the supply of air drawn through the burners into the furnace. At each boiler a Bailey boiler meter is installed to guide the firemen in maintaining just sufficient draft to get about 15 per cent excess air for combustion. It has been determined by experiments that, with this amount of excess air, the highest furnace and boiler

*Chief Engineer, Day & Zimmermann Engineering & Const. Co.

FIG. 1. CROSS SECTION THROUGH THE STATION. THE TWO-LEVEL ARRANGEMENT GIVES CONVENIENCE IN OPERATION



efficiency is obtained, the flue gas containing about 10 per cent CO_2. To obtain sufficient draft to operate the boilers at 300 per cent rating, motor-driven induced draft fans are installed, which remove the flue gases from the boilers and discharge them up a short steel stack, supported on the building structure. One fan is installed for each boiler but the breeching is so arranged that each fan can serve either boiler.

To prevent discontinuance of service in case of interruption of the gas supply, the gas burners are of the combination type suitable for either gas or oil. A 20,000-gal. oil storage tank is installed to hold a ready

FIG. 2. COMBINATION GAS AND OIL BURNERS ARE INSTALLED

supply of fuel oil and, in case of continued interruption of the gas supply, tank cars can be brought alongside the boiler room and the oil pumped directly to the burners.

Natural gas has proved to be an ideal fuel for power plant use. The furnace design required is simple, and the furnace temperatures are fairly low so that repair to the brick work is not excessive. At the present time the gas supply is so large that prices are reasonable, the cost of this fuel delivered in large quantities as have a capacity of 8500 gal. per min. when the entrance pressure is 7 lb. gage. Figure 3 shows the spray pond in operation.

Generator cooling is by outdoor air which is cleaned by a spray washer, the air, after passing through the generator, being discharged into the turbine room. In warm weather, this air finds its way out of the building through open windows but, in cold weather, the air is recirculated through the air washer, thus maintaining a comfortable room temperature by means of waste heat

Principal Equipment in Amarillo Station

Boiler Plant

2 Stirling type boilers, Babcock & Wilcox Co.
Heating surface each, 8343 sq. ft.; superheating surface each, 1500 sq. ft.; steam pressure, 300 lb.; temperature, 650 deg. F.
Gas burners, Forney Combustion Eng. Co.
Fire brick, LaClede Christy Clay Prod. Co.
Boiler settings, Geo. Allen & Sons.
Breeching and stack, Connery and Co.
Induced draft fans, B. F. Sturtevant Co.

Turbine and Condensing Plant

1 Main turbine, 5000 kw., General Electric Co.
Steam pressure at throttle, 260 lb. gage; temperature, 650 deg. F.; exhaust, 2 in. Hg. absolute; condenser, 8500 sq. ft., Westinghouse Elec. & Mfg. Co.
3 Circulating pumps, Westinghouse Elec. & Mfg. Co.; 6000 g.p.m. at 35 ft. head; two 10,000 g.p.m. at 65 ft. head; drive, 115-hp. Westinghouse turbine, gear-connected; 125-hp. Westinghouse squirrel cage motor.
2 Hot-well pumps, Westinghouse Elec. & Mfg. Co.; capacity each, 250 g.p.m. at 110 ft. head; drive, 10-hp. Westinghouse turbine; 10-hp. Westinghouse squirrel cage motor.
2 Air pumps, 2-stage steam jet, Westinghouse Elec. & Mfg. Co.; capacity each, 12 c.f.m.
Spray nozzles and piping, Yarnall-Waring Co.; concrete spray pond, 320 ft. by 88 ft. by 4 ft. deep.

Feed Water Equipment

Deaerating heater, Elliott Co.; 80,000 lb. per hr.
2 Boiler feed pumps, 300 g.p.m., DeLaval Steam Turb. Co.; drive, 110-hp. DeLaval steam turbine; 125-hp. Allis-Chalmers slip ring motor.
Boiler feed pump speed control, Hagan Corp.

Other Mechanical Equipment

2 House service pumps, 600 g.p.m., Warren Steam Pump Co.; drive, squirrel cage motor; steam turbine.
Crane, 3 motor, 25-t., Niles Crane Corp.
Feed water regulators, Northern Equip. Co.
Water columns, Babcock & Wilcox Co.
Gate and globe valves, Lunkenheimer Co.
Non-return valves, Foster Eng. Co.
Atmospheric relief valve, C. H. Wheeler Mfg. Co.
Pipe fabrication, Standard Piping & Fitting Co.; erection, Day & Zimmermann Eng. & Const. Co.
Air washer, Spray Eng. Co.
Machine shop equipment, Niles Tool Works.

Electrical Equipment

Generator, 5000-kw., 80-p.f., 3600-r.p.m., General Electric Co.; 13,-200-v., 3-phase, 60-cycle.
Direct-connected exciter, 28 kw., 125 volt.
Steam-driven exciter, 35 kw., 125 v.
Storage battery, 15 amp. 8 hr.
Motor-generator, 2.4 kw.
4 Main transformers, 1000 kv.a., 13,200-44,000-v., YY, Pittsburgh Transformer Co.; outdoor, self-cooled, single-phase.
3 Auxiliary transformers, 200 kv.a., Pittsburgh Transformer Co.; outdoor, self-cooled, single-phase..

Meters and Instruments

Feed water meters, steam flow meters, boiler meters, Bailey Meter Co.
Temperature recorders, Foxboro Co.
Thermometers, Taylor Instrument Co.
Pressure gages, Crosby Steam Gauge Co.
Main switchboard, Westinghouse Elec. & Mfg. Co.
Station switchboard, General Electric Co.
Frequency recorder, Leeds & Northrup.
Indoor disconnecting switches, Electric Power Equipment Corp.
Outdoor disconnecting switches and structures, Delta Star Electric Co.
Lightning Arresters (oxide film), General Electric Co.; 3 13,200-v.; 1 44,000-v.

required by this power plant amounting to about 10 cents per million B.t.u.

On account of the low-priced fuel it was considered unnecessary to install the latest refinements for obtaining high efficiency, so simplicity and accessibility were made the keynote of the design in order to assure continuity in operation. The design of the plant is such, however, that good economy is obtained at present and also efficient operation can be had in the future with pulverized coal, should gas and oil become prohibitive in price.

Steam from the turbine is condensed in an 8500-sq. ft. surface condenser. Circulating water in large quantities required for condensing purposes is not available in this location, so it was necessary to install a spray pond to cool the circulating water, the make-up water for the spray pond being obtained from wells. The spray pond is made of concrete, 88 ft. wide by 320 ft. long, with water sprayed through 210 nozzles which from the generator and also preventing the air washer from freezing.

Condensate from the turbine is pumped to a deaerating type feed-water heater where it is heated to 210 deg. F. by exhaust steam from the auxiliary turbines and by steam bled from the main unit. Boiler feed make-up water is introduced in the feed-water heater. One motor-driven and one turbine-driven centrifugal boiler feed pump are installed, each of sufficient capacity to feed both boilers. The speed of these pumps is controlled by Hagan regulators to maintain a predetermined pressure in the discharge line of the pumps.

The turbine generator is a single-cylinder, 6250-kv.a., 3-phase, 60-cycle, 13,200-v. unit at 3600 r.p.m., with a 34-kw., 125-v. direct connected exciter. A 35-kw., 125-v. steam turbine-driven exciter serves as a spare. The generator voltage is controlled by a vibrating type regulator with switches, whereby either the direct-connected exciter or the steam-driven exciter may be used. Indi-

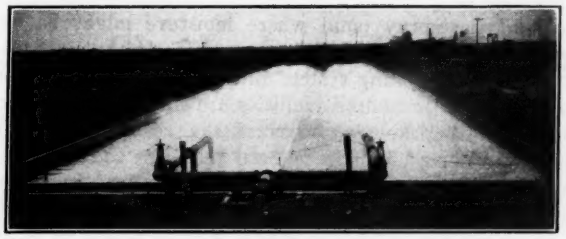


FIG. 3. 8500-G.P.M. SPRAY POND FOR COOLING WATER

vidual regulators of this type are to be used with each generator so that it will be possible to use the spare exciter with any of the main units.

CENTRAL ELECTRICAL CONTROL IS FROM MAIN SWITCHBOARD

Each feeder is provided with selector type disconnecting switches whereby it may be connected through an oil circuit breaker to the main station bus or directly to an auxiliary or transfer bus. In the latter case, protection for the feeder is provided by the oil circuit breaker and relays on the bus transfer panel. All oil circuit breakers are solenoid operated from a 120-amp.hr., 125-v. control storage battery and are mounted in concrete cells above which are the buses and disconnecting switches. Normally a trickle charger floats on the battery, carrying the steady control circuit load and maintaining the battery in a fully charged condition. In case of trouble with the storage battery, the trickle charger, or connections, the control circuits may be operated directly from the spare exciter, or the battery may be charged in the ordinary manner from the spare exciter.

The main switchboard, of 17 panels and a swinging bracket, is located, together with the oil circuit breakers and instrument transformers, on the operating floor in the electrical bay at the generator end of the turbine room. All potential transformers are housed in concrete cells with the current transformers mounted on the building wall above the cells.

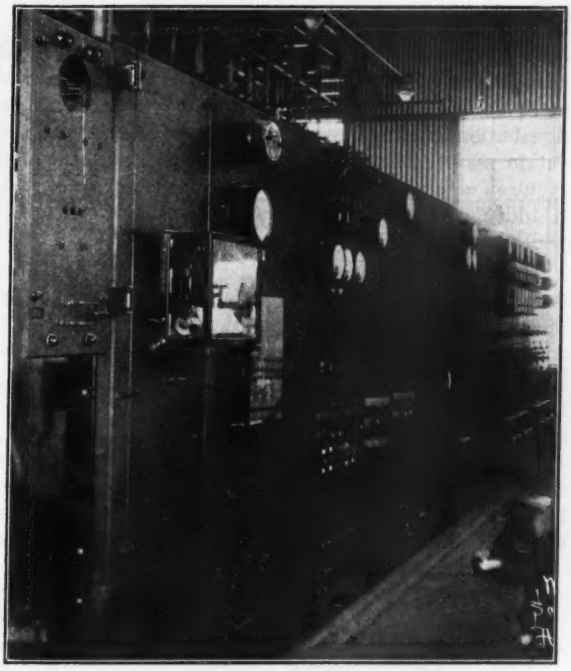


FIG. 5. CONTROL OF GENERATORS AND LARGER MOTORS IS FROM THE MAIN SWITCHBOARD

All station auxiliary motors are 3-phase, 60-cycle, 440-v., designed for full voltage starting. The station service power supply is obtained from the main bus through transformers and the 440-v. circuits are controlled by the station service switchboard on which the switching is accomplished by magnetic contactors mounted on the panels. Individual feeders are used for the larger motors, such as circulating pump, induced draft fan and boiler feed pump motors, the contactor

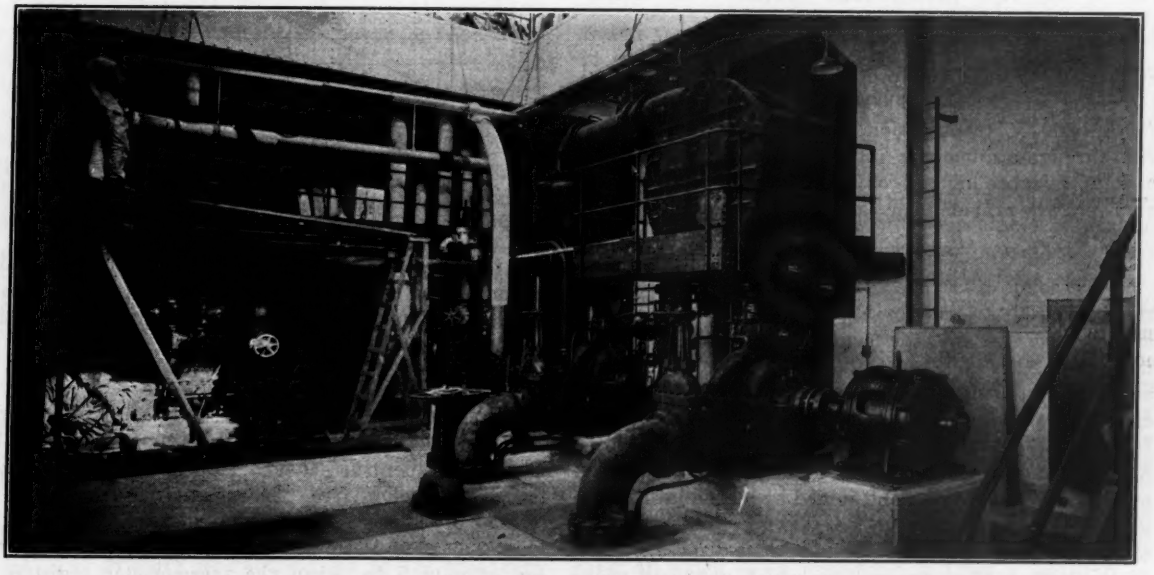


FIG. 4. PLATFORM IS INSTALLED FOR EASY ACCESS TO CONDENSER TUBES

on the switchboard serving as a line switch for the motor, which is started and stopped by push buttons located near the motor and controlling the contactor on the motor feeder. Smaller motors receive power from a distribution cabinet supplied by one feeder from the station service board. Fuses and switches in the distribution cabinet protect the individual motor lines and, in addition, each motor is provided with its own overload protection.

General illumination only is used throughout the station with the exception of water column illuminators. Liberal lighting is provided as the high degree of illumination is of material assistance to the operating force. Holophane units are used in the electrical bay and provide illumination of the overhead buses as well as ample light for the working areas.

Outdoors a line take-off structure is provided for three 13,200-v. feeders, two of which are to be tie feeders between the old and new power houses. A transformer and switching structure for three local distribution cir-

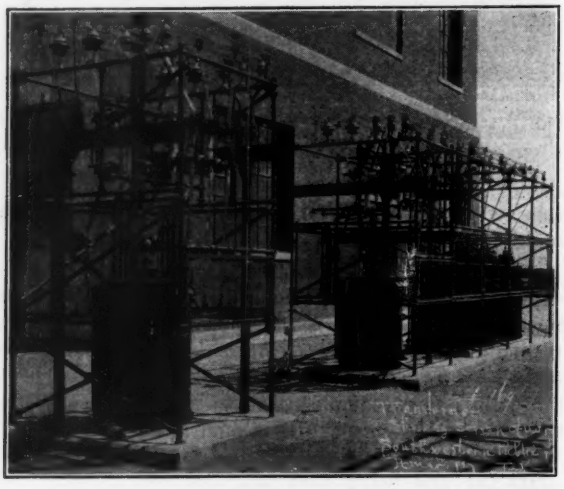


FIG. 6. OUTDOOR TRANSFORMER STATION HAS SCREEN GUARDS

cuits at 2300 v. is also provided. A transformer and switching structure of 3000 kv.a. capacity is provided for a 44,000-v. transmission line extending from Amarillo through a number of intermediate towns to Pampa, a total distance of approximately 60 mi. Lightning arresters are provided for each outgoing circuit.

Dry Soil Made Grounding a Problem

On account of the exceedingly dry nature of the soil, the grounding system presented some difficulty. Generators operate with the neutrals grounded; also the neutral of the 44,000-v. transformers is grounded, in addition to the necessary grounding of structures, machinery frames, etc. Soil resistance is very high since, for a greater part of the year, the moisture content is negligible. A large number of ground rods were driven over a considerable area and joined by a combined clamp and soldered connection to a 0000 bare wire, a number of rods being driven in the sewage-disposal fields, in the bottom of a dry well to which any rain water from the roof is drained, and a line of rods was driven around the spray pond where moisture might be expected. In addition to this, connections were made between the grounding system and all water pipes. Since all available grounding facilities are connected together, it is impracticable to measure the resistance of the ground system but it is believed that, due to the extent of the grounding circuit and the number of rods and also the fact that certain sections will be kept more or less moist, the ground resistance will be as low as could be obtained in this locality.

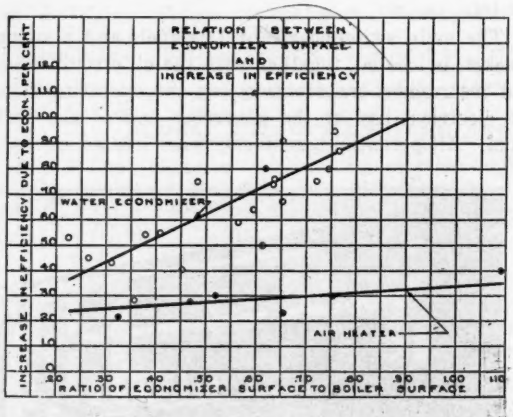
Originally it was planned to put the power plant in operation on May 1, 1927. All work was scheduled accordingly and ground was broken on Nov. 5, 1926, but load on the old plant increased so rapidly that orders were given, in the middle of December, to have the plant complete by March 1. This new schedule reduced the allotted time for construction from 5 mo. to 3 mo., but, despite this fact, the plant went into commercial operation on Feb. 28, a day ahead of time.

An additional 5000-kw. turbo-generator is now being installed and will go into service about Dec. 1, 1927, which will bring the capacity of the new station up to 10,000 kw.

The plant was designed and built by Day & Zimmermann Engineering and Construction Co. of Philadelphia, Pa., in conjunction with the engineers of the Southwestern Public Service Co.

Economizers Increase Boiler Efficiency

DATA COLLECTED by the N. E. L. A. and plotted on the curve show a definite relation between the gain in efficiency effected by economizers and air preheaters


RELATION BETWEEN ECONOMIZER SURFACE AND INCREASE IN EFFICIENCY
INCREASE IN EFFICIENCY DUE TO ECON. PER CENT
WATER ECONOMIZER
AIR HEATER
RATIO OF ECONOMIZER SURFACE TO BOILER SURFACE

and the ratio of their heating surface to boiler heating surface. The data plotted indicate the performance of numerous plants, each plant in the figure representing an individual installation.

ORDINARY COPPER wire, as usually used in long distance telephone circuits, contracts approximately 1½ in. in a temperature change from 100 deg. above zero to 10 deg. below zero, the contracting increasing the tension of the wire and causing shortening. The wire, having a sag of 16 in. at 100 deg. above zero, will have a sag of only 5 in. when the thermometer registers 10 deg. below zero.

Turbulent Burners for Pulverized Coal

To Secure Proper Mixture of Pulverized Coal and Combustion Air and to Shorten Flame Travel, Thus Decreasing Furnace Volume, Various Types of Burners Have Been Developed. By S. C. Martin

IN ORDER to realize to as great an extent as possible the advantages to be derived from firing coal in pulverized form, it is necessary that particular attention be paid to the method employed for mixing the fuel and the air required for combustion, and the manner of introducing the resulting mixture into the furnace for firing. To accomplish these results is the function of the pulverized coal burner and considerable attention is being directed to this important part of pulverized fuel equipment.

There is a trend toward smaller furnace volume, and this smaller volume necessitates a shorter pulverized coal flame, consequently the completion of combustion within a short distance of the mouth of the burner.

To meet these conditions, several types of short flame burners have recently been developed in which an intimate mixing of the pulverized fuel and combustion air, and the rapid spreading of the flame throughout the mixture after it is ignited, is brought about by inducing a turbulent condition in the fuel and air in its passage

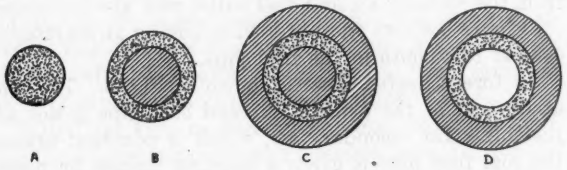


FIG. 1. POSSIBLE RELATIONS OF AIR AND COAL STREAMS IN CIRCULAR BURNER. SHADING REPRESENTS AIR ALONE

through the burner or at its mouth, and which is continued after the mixture enters the furnace.

There is perhaps a greater latitude in burner design than in any other part of pulverized fuel equipment, for the factors entering into the operation of burners are numerous and variable. The different methods of firing in relation to the furnace are to be considered, such as the horizontal and the vertical, as well as the furnaces for the different types of boilers, and the conditions of water cooled and air cooled walls and the ordinary refractory walls. It may also be desirable to equip the furnace to burn oil or gas either separately or simultaneously with pulverized coal. There is the unit system and the storage or bin system with the different methods of transporting the powdered coal to the burner, as well as the conditions of air supply.

Air Supply

In the design and operation of a pulverized coal burner the most important factor to be considered is the air required for combustion, the various conditions to be taken into account being as follows:

Temperature of the air, whether at room temperature or preheated.

Ratio of primary or carrying air to the secondary air supply.

Primary air pressure.

Secondary air pressure, that is natural or forced draft.

Relation of the air stream to the coal stream.

Method of inducing turbulence.

Method of mixing air and fuel.

Regulation of the air supply.

The primary air may be heated, where heated air is drawn through the pulverizer with the pulverized coal as in the unit type machine; or the secondary air may be preheated as when it is drawn through the

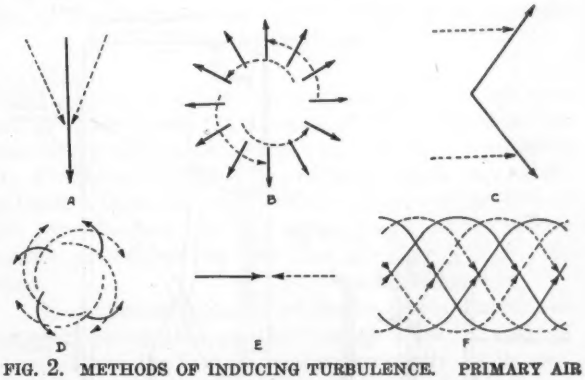


FIG. 2. METHODS OF INDUCING TURBULENCE. PRIMARY AIR AND FUEL ....., SECONDARY AIR .....

furnace walls or other heated part of the setting; or both the primary air and secondary air may be heated. In such cases the volume of air for combustion which passes through the burner is greater than with air at a lower temperature, accordingly the burner must be made larger or forced draft resorted to.

The amount of carrying air as well as its pressure varies to a considerable extent as supplied by the different types of unit machines having direct connected or separate fans, as well as with the different air transporting systems used with the storage type of installation. The quantity may vary from a small percentage of that required for complete combustion, to practically all of the entire amount necessary.

Relation of the fuel and air streams to each other as they flow through a burner of circular cross section may be as shown in Fig. 1. Here "A" shows one stream of mixed fuel and air as in the simplest form of burner. "B" is a central column of air surrounded by a concentric ring of mixed fuel and primary air. "C," a cylinder or ring of mixed fuel and air, having a central column or core of secondary air, and in addition an outside concentric cylinder of air. "D" shows a cylinder of mixed fuel and air having a concentric cylinder of secondary air in contact with its outer surface.

Turbulence, in these different bodies of air and mixed fuel and air, may be induced in various ways, chief of which is by imparting to them a whirling or rotary motion, Fig. 2, by means of a series of slanting or curved vanes through which they must pass before

entering the furnace. The streams of fuel and air then impinge on each other at an angle as they approach from different directions, and eddies are set up in the whirling mixture, producing the necessary turbulence at the mouth of the burner.

In addition to this turbulence the direction of the stream of fuel and air is, in some types of burners, deflected from its axial direction by means of a conical deflector or one composed of radial blades, so that a flaring flame is produced. This deflection of the stream of fuel and air is also made use of to assist in producing turbulence.

The majority of these short flame or turbulent type burners are of circular cross section, but where a horizontal burner must be adapted to a water cooled wall

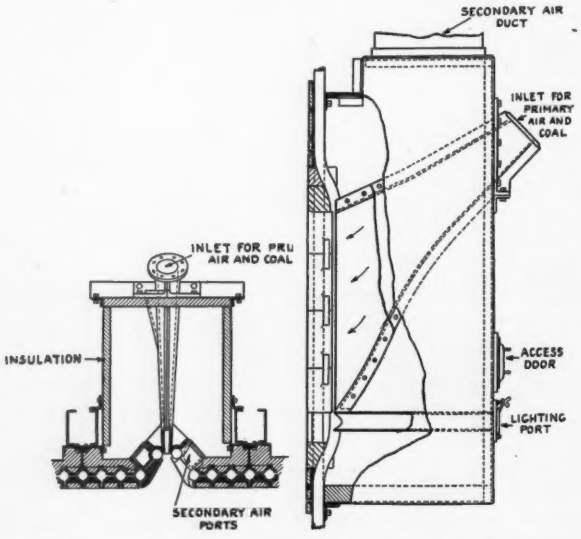


FIG. 3. BURNER DESIGNED FOR INSTALLATION THROUGH WATER-COOLED FURNACE WALL

and enter between the tubes, a long narrow vertical opening or slit is desirable.

Regulation of the primary air supply when a unit pulverizer is employed is generally effected at the pulverizing machine by controlling with dampers the amount of air entering it when the fuel supply is changed. Regulation of secondary air supply may be accomplished by means of dampers at the burner or in the secondary air duct. Turbulence is regulated by changing the angle of the vanes or the position of the deflector when one is used; the latter controlling to some extent the length of the flame.

It is hardly possible to attempt any general classification of these turbulent type burners. Those shown in Figs. 4, 5, 6, 7, are similar to the extent of employing a central pipe or nozzle for the primary air and coal feed, and also some form of diffuser at the end of this pipe, adjustable in most cases in an axial direction. Several other burners employ a plenum chamber or wind box surrounding the burner proper, from which the secondary air supply is taken.

The burner shown in Fig. 3 is a horizontal type designed especially for a certain kind of water-cooled furnace wall. The primary air carrying the powdered coal is injected into the furnace through a long, narrow vertical slot between the water-cooling tubes, the amount of primary air being a small percentage of the total quantity required for combustion.

The secondary air enters through ports arranged alternately on either side of the primary fuel slot, and are so placed that the secondary air comes in contact with the primary fuel and air mixture at an angle.

Refractory faced plates separate the air ports, of which there are several on each side.

Figure 4 illustrates a horizontal type of burner of circular cross section which is used with a furnace having a refractory front wall, through which the burner is introduced. This burner may be designed for any percentage of primary air available and secondary air may be supplied with either natural or forced draft.

Primary air and coal is forced through the central supply pipe and as it enters the furnace is directed away from its longitudinal line of travel by the conical deflector, and spread out at an angle to the burner opening. Secondary air enters through the surrounding pipe and in passing through the vanes is given a whirling motion before it strikes the fuel and air mixture. Regulation of the secondary air is effected by means of the circular damper plate which may be moved along the pipe by means of handles, thus changing the circumferential air opening between the edge of the plate and the opening in the burner. The distance of the deflector from the primary air and fuel outlet may also be varied.

Figure 5 shows another burner having an adjustable cone at the mouth of the feed pipe.

A forced draft burner is shown in Fig. 6. The cone at the end of the primary air and coal pipe is not adjustable. The secondary air, which is admitted around the coal feed pipe is given a whirling motion by means of curved vanes which extend outward from the mouth of the coal feed pipe toward the interior of the furnace. A flaring stream or hollow cone of primary air and fuel is thus cut by tangential jets of secondary air, and turbulence thus induced continues to the mouth of the burner. Dampers control the supply of secondary air passing through the wind box.

In Fig. 7 the burner illustrated carries a rosette diffuser at the end of a pipe which extends horizontally through the center of the burner and which may be so adjusted as to vary the distance of the diffuser from the mouth of the burner.

In operation of this burner pulverized coal, carried in suspension by primary or conveying air, enters the chamber "A" through a flanged connection and is given a circular motion before entering the outlet pipe "B" in which it continues to revolve around the axis as it passes toward the mouth of the burner. The vanes "D" are arranged parallel to the axis of the pipe and at an angle to the radius so that the coal is diverted toward the center, thus counteracting the action of centrifugal force which tends to cause the coal to travel in a zone adjacent to the inner surface of the pipe.

As the coal passes to the tip of the burner, it completely fills the space between the two pipes and in passing through the diffuser the coal streams are broken up into a number of stratified streams which are diverted into a conical form or flare.

The inclined vanes "E," having their axes parallel to the pipe, are adjustable and give the secondary air a

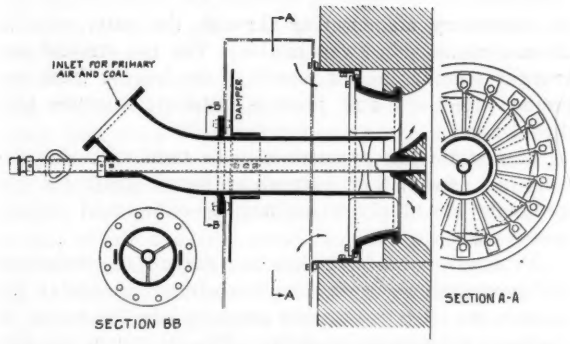


FIG. 4. BURNER FOR REFRACTORY WALL, WITH ADJUSTABLE CONICAL DEFLECTOR AND VANES TO WHIRL SECONDARY AIR

whirling motion when passing between them. The amount of whirl is determined by the angular position of these vanes, and the direction of rotation of the secondary air is, in general, opposite to that of the primary air and fuel although the vanes are so arranged that they will give the secondary air a rotation in either direction.

Mixing of the primary air and coal and the secondary air occurs beyond the tip of the burner; the coal stream issuing in the form of a flare is violently whipped by the stream of secondary air issuing around it, the two streams being in rapid rotation. Impingement of the coal on the vanes results in strata consisting of alternate rich and lean mixtures of air and coal. The rich portions of the stream ignite readily and serve as kindling to the remainder of the mixture.

Initial ignition in this burner may be made by a flare torch introduced through openings provided for the purpose, or an oil tip may be introduced through the central pipe, or a wood fire may be started in the furnace.

When starting the fire, the means for lighting is first introduced close to the tip of the burner. Primary air and coal are then admitted without any secondary air. Ignition of this rich mixture is practically immediate. Dampers in the secondary air chamber are then slowly opened and the amount of air adjusted to the amount of coal burned. The degree of flare is adjusted by advancing or retarding the pipe which carries the diffuser. With the rosette advanced beyond the end of the pipe the flare will be greatest, and with the rosette drawn entirely within the pipe the flare will be the least.

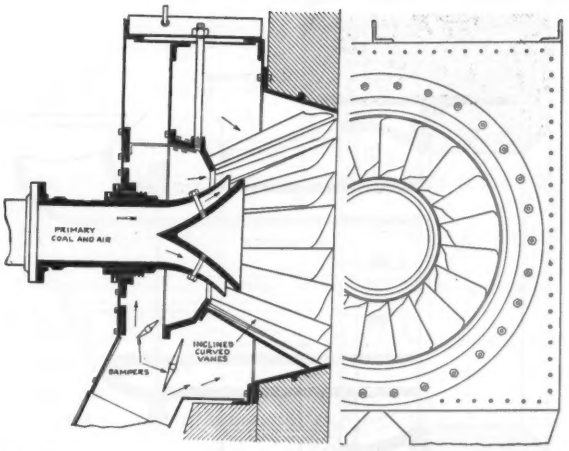


FIG. 6. THIS BURNER HAS A FIXED CONE AND IS DESIGNED FOR FORCED DRAFT

The maximum capacity of the burner is determined by the velocity through the opening from the plenum chamber into the furnace, and consequently by its size. The minimum capacity is determined by the minimum amount of air required to carry the coal to and through the burner. In this latter case the secondary air dampers are closed and the coal and air pipe and rosette act as the burner. The rosette is cooled by the flowing coal and air and the front plate is protected by a cast iron shield. The brickwork is flared so as to accommodate the flame.

The connecting flange to the secondary air chamber, and also the dampers which are operated with a handle by means of worms and worm gear segments, may be so placed that the secondary air can be admitted from either top or bottom or either side of the chamber. The

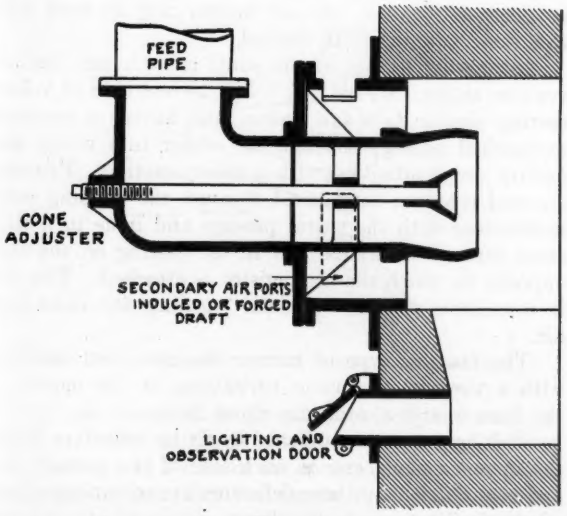


FIG. 5. ANOTHER TURBULENT BURNER WITH ADJUSTABLE CONE

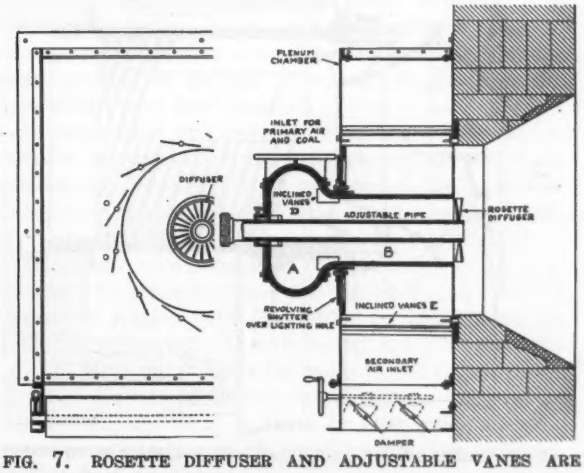


FIG. 7. ROSETTE DIFFUSER AND ADJUSTABLE VANES ARE FEATURES OF THIS TYPE

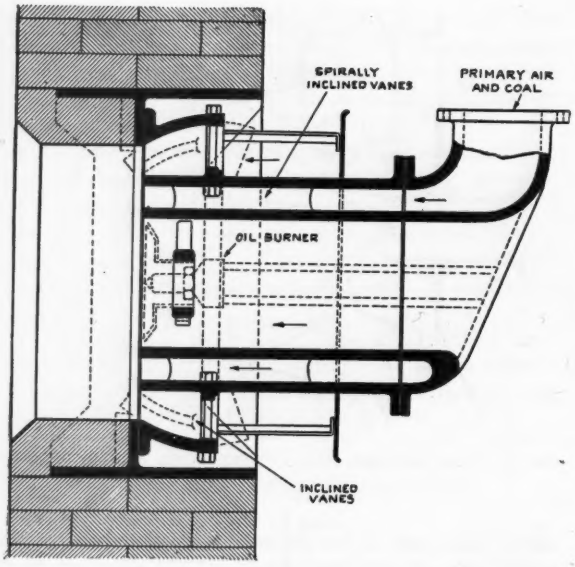


FIG. 8. RELATION OF AIR AND COAL STREAMS IS SIMILAR TO FIG. 1C. STREAMS JOIN AT BURNER MOUTH. OIL BURNER CAN BE USED IN COMBINATION OR FOR IGNITING

primary coal and air chamber may also be located to permit an assembly having the inlet flange to the left or to the right of the vertical center line, the drilling and reversibility permitting of several positions of the flanged inlet.

The burner in Fig. 8 differs from the majority of turbulent burners in that the secondary air, and primary air and fuel streams passing through the burner have a relation similar to that shown in Fig. 1C. Spirally inclined vanes in the primary coal and air passage give to the mixture a clockwise rotation, while the secondary air entering through the outer pipe is given a counter-clockwise motion. The two streams are brought together at the mouth of the burner from opposing directions and produce intimate mixture and turbulence.

Low static fan pressure may be used with the primary air, and either natural or forced draft for the secondary air supply which may be either cold or preheated air.

Provision is made for burning gas, oil, or pulverized coal separately or in combination without change in the burner, the oil burner being supported in the center of the inner air passage as shown. The oil burner can also be used for igniting the powdered coal when the fire is started.

In the burner shown in Fig. 9 primary air and coal are admitted at the side of a circular passage or pipe communicating with the furnace, and is given a whirling motion by means of spiral vanes on the inner circumference of the pipe. Secondary air enters through specially constructed adjustable doors of the air registers, either through natural draft alone or by means

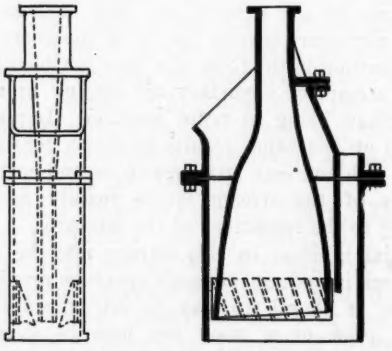


FIG. 10. FORCED DRAFT FAN TAIL BURNER HAS BEEN EQUIPPED WITH DEFLECTORS TO PRODUCE TURBULENCE

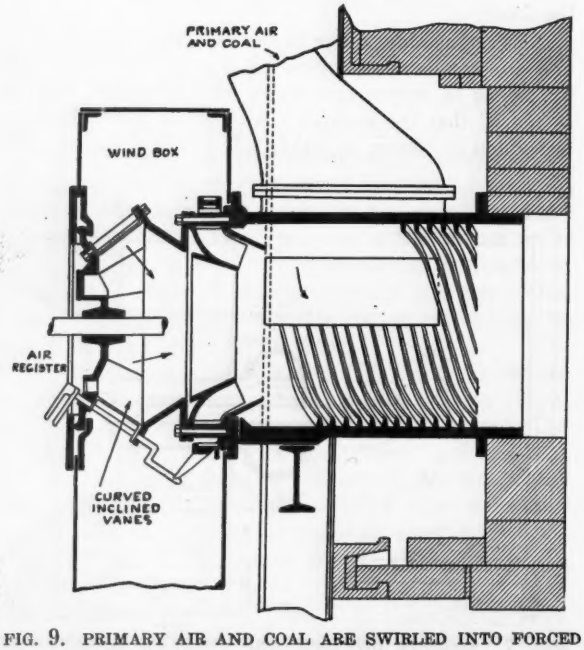


FIG. 9. PRIMARY AIR AND COAL ARE SWIRLED INTO FORCED OR NATURAL DRAFT SECONDARY AIR. PROVISION IS MADE ALSO FOR AN OIL BURNER

of a forced draft fan delivering air under pressure to the wind box. In either case this secondary air is given a rotary motion through the furnace throat into the combustion chamber. An oil burner may be used with this same equipment if desired.

In another burner of this same manufacture the air register shown in Fig. 9 is bolted to one side of volute casting similar to a fan casing, and having a separate cylindrical passage through the center into which secondary air is admitted with a rotary motion. Primary air and coal are introduced through the opening communicating with the spiral passage and issue in a thin sheet through a circular slit in the casting on the side opposite to which the air register is attached. This slit is concentric with the circular opening for secondary air.

The fan tail type of burner has also been modified with a view to producing turbulence at the mouth of the burner and a resulting short flame.

This has been accomplished by fixing deflectors inside the burner casing, one on each side of the primary air and coal nozzle. In these deflectors are serrations which admit auxiliary air to the flame.

Figure 11 is a burner arranged for burning either gas, oil or pulverized coal in any combination. It con-

sists essentially of an involute passage for the introduction of pulverized coal, which is of such shape that an even density of the coal and air mixture discharged from the annular mouth is maintained at all times. This coal and air mixture as it passes through the involute is given a whirling motion in one direction and while the secondary air admitted through the air register under forced or natural draft is given a whirling motion in the opposite direction. These opposing streams of air and fuel cause violent turbulence when they meet at the mouth of the burner. An inner venturi tube is provided in the air register through which air may be discharged into the center of the turbulent mixture, thereby controlling the amount of the turbulence.

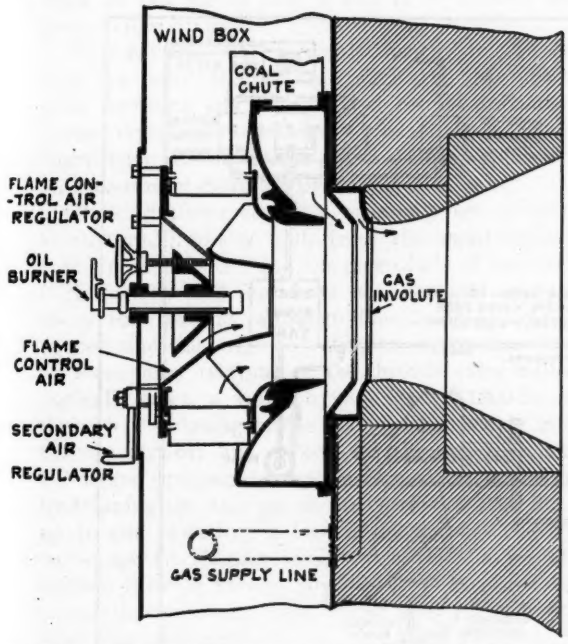


FIG. 11. COMBINATION BURNER IN WHICH PRIMARY AIR AND COAL WHIRLS IN OPPOSITE DIRECTION TO SECONDARY AIR

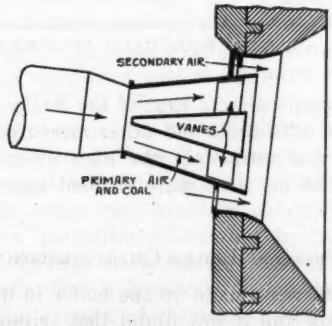


FIG. 12. ANOTHER TYPE OF TURBULENT BURNER

The gas involute is placed ahead of the coal involute and next to the brickwork, while the oil burner tip is inserted in a hole in the center of the air register.

Means are provided for regulating the different air supplies, the same air control being used for all three fuels.

Figure 12 shows still another type of burner in which the stream of primary air and coal, deflected by the cone, meets secondary air entering through the register as shown. This secondary air also helps to cool the burner opening.

General Requirements

The general requirements of a good burner for pulverized coal are:

Good combustion with minimum as well as maximum rating.

Simple regulation of ratio of fuel and air, and quantity of fuel air mixture.

Least possible resistance to flow of fuel and air through the burner.

Easy lighting.

Minimum amount of metal exposed to furnace radiation.

The selection of a burner for any particular type of pulverized fuel installation and its location in the furnace wall require as much engineering skill and experience as the choice and installation of any other part of pulverized fuel equipment.

Power Outlets in New Buildings

NOT LONG ago the writer visited a large textile mill, the principal building for which was only 3 yr. old. In spite of the comparative newness of the building, subsequent changes to machinery had made necessary the cutting of a gutter in the concrete floor to provide a place for needed electrical conduits and the rearrangement of the overhead power transmission shafting. Much of this expensive alteration would have been saved had the original plans called for a greater abundance of power outlets and a simpler system for power transmission.

One common mistake of industrial builders is locating power outlets where they will be immediately needed, but failing to provide extra outlets for possible future changes or needs. When extra outlets are needed it will be found that cutting into a concrete floor is an operation far more expensive than the installation of what might be considered too many outlets. It is economical practice, in the great majority of cases, to place power panels at close intervals in wall-columns, where possible in ceiling boxes, and to gridiron the floors with power line ducts.

In rooms that will require steam, air, gas or water, adequate provision for extra supply should be made available by the insertion of tees, or by the actual installation of additional pipe lines which, until needed, may remain unused.

What may seem a needless expense for power, steam, air, water or gas equipment not needed at the time the building is erected, will frequently be found a highly profitable investment. It costs money to install conduits and pipe lines but it costs far more to cut a floor, alter a well, or change an entire piping system. And after all, who can say what in three or four years may be necessary not only out of consideration for economy but for sheer existence.

1200-Lb. Turbine Shows 80 Per Cent Efficiency*

THIS 7000-KW. UNIT IS 10 PER CENT MORE EFFICIENT THAN 300-LB. EQUIPMENT WITH WHICH IT OPERATES AND USE WITH 160,000-KW. OF 300-LB. TURBINES IMPROVES THE STATION ECONOMY 3 PER CENT

AFTER A MONTH'S OPERATION, accurate water rate tests were made on a 7000-kw., 1200-lb. turbine in order to determine its efficiency and the improvement in station economy which it effected. Taking into account the lack of accurate knowledge of properties of steam at high pressures and the lack of experience with turbines for those pressures, agreement with the design capacity and expected economy are good. The unit is rated at 7000 kw. at 90 per cent power factor and operates at 3600 r.p.m. The spindle contains 20 stages of impulse buckets, the wheel being machined integral with the shaft from a nickel steel billet. The turbine exhausts at approximately 300 lb. gage to a radiant heat reheater in the high pressure boilers. From the reheater the steam passes through the station header supplying steam to the regular 300-lb. turbines. A diagrammatic arrangement of the station is shown in Fig. 1.

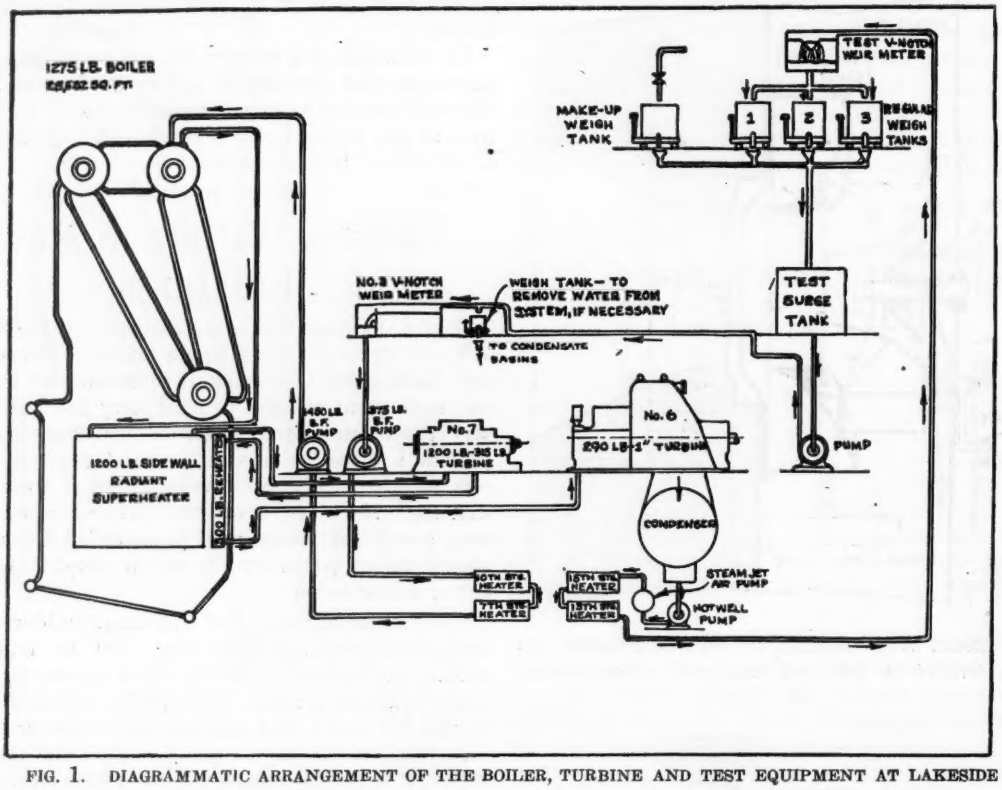


FIG. 1. DIAGRAMMATIC ARRANGEMENT OF THE BOILER, TURBINE AND TEST EQUIPMENT AT LAKESIDE

Based on the shaft output of the turbine, the Rankine cycle efficiency ratio was found to be 80 per cent at 7000 kw. or based on the electrical output, 75 per cent at the same load. Efficiencies for other loads are shown on the curve in Fig. 2, together with the water rate in pounds per kilowatt-hour.

During two weeks of recent continuous operation, the 1200-lb. turbine with its complement of low pressure turbine capacity fed with the exhaust steam generated 33 per cent of the station output and an improvement of about 3 per cent in station economy was experienced. From boiler heat balances and turbine tests, it is calculated that the high pressure unit is 10 per cent more efficient than the 300-lb. equipment, of which there is installed capacity of 160,000 kw.

Heat absorption efficiency of the high pressure boiler unit is not comparable to that of the 300-lb. boilers due to air heater difficulties and other measured losses. It is expected that ultimately the high pressure installation will be 15 per cent more efficient than the 300-lb. equipment.

HIGH PRESSURE BOILER CHARACTERISTICS GOOD

Some tests were made on the boiler to determine its characteristics, and it was found that tripping 10 of 12 feeders simultaneously has no effect on the boiler water level, while sudden popping of a safety valve causes only slight oscillation of the water column. At 300 per cent boiler rating the water level is nearly stationary while high water marks in the rear drum show practically the same water level as in the front drums. It appears that the 1200 lb. pressure produces a better performing boiler because of the smaller size of the

*From the serial report of the Prime Movers Committee of the N. E. L. A. dealing with higher steam pressures and temperatures.

steam bubbles and less difference in the steam and water density.

Total consumption of auxiliaries of the high pressure boiler and turbine as metered over a two weeks' period is reported as 2.6 per cent of the total electrical output by the 1200-lb. steam. Of this 1.5 per cent was used by the 350-lb. and 1400-lb. boiler feed pumps. The total figure of 2.6 per cent includes all feed pump charges, although it does not include energy for auxiliaries in the 300-lb. unit using the exhaust of the 1200-lb. turbine.

Installation of a 16 mesh per inch steam screen before putting the turbine into service has proved helpful in maintaining turbine efficiency, even though all pipings and fittings were cleaned and inspected thoroughly before erection. Foreign matter collected in such quantities on this screen that it had to be cleaned several times before continuous operation was possible.

It is believed that the employment of this screen has kept the small blading and nozzles of the turbine in good condition and that the test results previously reported represent the efficiency when in good condition. Installation of fine screens on all turbines appears to be an exceedingly desirable practice.

Packing clearances were originally set at 0.005 in. axially and radially and, from the small amount of rubbing experienced and the magnitude of seal leakage, it is thought that they have not increased appreciably above this amount, although the casing has not been opened since the original bolting to verify this.

Emergency tripping of the throttle valve will automatically open a valve, bypassing the 1200-lb. steam through a reducing orifice and de-superheater into the turbine exhaust line. Tests for the operation of this automatic equipment were performed on one occasion by tripping the unit out at increments of 1000 kw. load up to and including a load of 5000 kw. The bypass valve opened simultaneously with the closing of the turbine throttle valve. No apparent ill effects of the automatic operations were visible and the boiler water level was motionless.

Water Rates Determined by Three Methods

Water rates were determined simultaneously by three different methods. By weighing feed water to the 1300-lb. boiler serving the turbine, by weighing condensate returned from a 300-lb. condensing turbine connected in compound with the 1200-lb. turbine and condensing all of its exhaust, and by measurement of the temperature drop from the throttle to the exhaust of the 1200-lb. turbine. Since both temperatures were superheat temperatures, the total drop, and therefore indirectly the water rate could be obtained by calculation.

Water quantities circulating in the high pressure system was thus measured from the turbine and to the boiler, affording a double check of the weighed water rate. The amount of the make-up to maintain normal level was determined by actual weight. The three methods indicate approximately the same water rate. Tests were of 5 and 6 hr. duration and the results are thought to be accurate within 1 per cent plus or minus.

Arrangement of the test apparatus is shown in Fig. 1 and includes four meters, two of which are of the weir type for checking consistency of the weighed water rate. Referring to the upper right-hand corner of the diagram, the flow of condensate through the system is traced through a V-notch meter through the 5000-lb. weigh tank into a surge tank, to a pump, a second test V-notch meter, through the pump and two stages of extraction heaters to the 1300-lb. boiler. Exhaust from the 1200-lb. turbine is returned to the boiler for reheating and is then used in the 300-lb. turbine, returning to the test weighing tank to complete another cycle. As shown in the sketch, provisions were made to add or subtract water from the test system. Standard weights were used to check the three weighing scales and the electrical output was measured with standardized indicating watt meters. In the seventh and tenth stage extraction heaters in which 370 lb. feed water was circulating, a possible source of error occurred. Leakage of the condensate of these heaters would be returned to the hotwell of the lower pressure extraction heaters

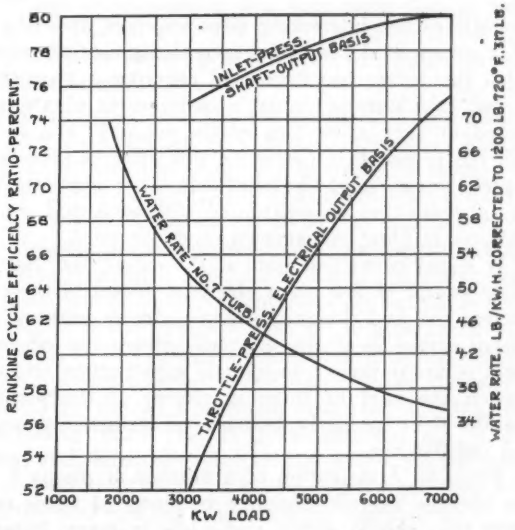

RANKINE CYCLE EFFICIENCY RATIO-PERCENT
WATER RATE, LB./KW.H. CORRECTED TO 1200 LB. 720°F. 3IN LB.
KW LOAD
INLET-PRESS. SHAFT-OUTPUT BASIS
WATER RATE-NO. 7 TURB. ELECTRICAL OUTPUT BASIS
THROTTLE-PRESS. ELECTRICAL OUTPUT BASIS

FIG. 3. TEST RESULTS AGREED WELL WITH THE MANUFACTURERS' GUARANTEES

without reaching the boiler until again weighed. Check before making the tests showed 10 per cent leakage in one of these heaters, which was corrected before the series of tests.

Possible leakage through the bypass valve, admitting 1200-lb. steam to the turbine exhaust line and reducing nozzle and desuperheater in case of emergency, was measured by a mercury manometer connected to read the pressure drops across the reducing nozzle. Condenser leakage was checked before the tests during shutdown, but no leakage was found at that time. Readings during the test by a Dionic tester indicated a 2 per cent leakage and observations after the test verified the readings of the Dionic instrument.

Double Valves Used on All Lines to the 300-Lb. System

Throughout the test it was necessary to remove about 1½ per cent of the condensate. Further checking the 2 per cent indication the condenser leakage test apparatus. Double valves isolated the test system from the remainder of the plant were employed in all cases except one. This exception was necessary by the need

of opening a 12-in. feed water valve when starting and ending the test to eliminate possible leakage through the closed valve pressures were maintained nearly identical on both sides.

Thermocouples peened into the throttle and exhaust pipe with leads covered by pipe insulation for a considerable distance were used to indicate throttle and exhaust temperatures and to solve for the heat drop in the machine. Steam for operating the steam jet pump on the 300-lb. turbine condenser and steam for the soot blowers was obtained from a source external to the test system. All drain valves on the superheated steam mains were closed and the line opened for inspection. Drains necessary during the tests were grouped and routed in the 13-stage extraction bleeder hotwell. Seal leakage steam was measured with orifices and a jet as shown in Fig. 3.

Study of leakage shows that the steam leaking from the 1200 lb. pressure to the 300-lb. pressure to be approximately 0.9 per cent. This steam passes to the exhaust of the turbine and is used in any low pressure unit. Leakages from the 300-lb. pressure seals are used to heat the feed water of a 30,000-kw. turbine and the steam leakage of the external seals of the high pressure unit is condensed and its heat regained in the hotwell basins.

Extracts from an Engineer's Reports

By C. T. Baker*

SOME rather interesting situations are disclosed by a review of the copies of several engineering reports which the writer has developed covering a number of ice and cold storage plants, electric power plants, etc., located in various sections of the country, and it has occurred to him that perhaps a few extracts from some of these reports might be helpful to other engineers who may at some time be confronted with somewhat similar problems in plant management and operation.

It might be well to state at the outset that the two major causes of low plant efficiency found in these investigations and which represent almost universal or typical causes in plants generally where low efficiency prevails, are improper design and construction and neglect on the part of those in charge of the plant to operate them properly because of laziness, ignorance and indifference.

From an examination of a number of plants I find the average overall efficiency in many of them much lower than should obtain and while in many instances this low efficiency is the result of poor plant design or poor plant erection, or a combination of the two, yet it is a fact that in most instances the trouble was due to the neglect of operating details and to poor housekeeping methods on the part of those charged with the management and operation of the plant.

Taking a concrete example of this condition, I quote from a report covering a steam-driven distilled water ice plant which the writer examined:

"One of the greatest single sources of loss in economy occurs in the boiler room where, due to neglect of operating details, as well as the neglect of proper maintenance, the fuel waste is enormous.

"At the time of my visit the highest CO_2 shown by careful analysis of the flue gases was found to be 5 per cent, whereas under good operating conditions a CO_2 content of from 12 to 13 per cent should be approximated with fuel oil furnaces.

"A 5 per cent CO_2 represents preventable fuel losses of 22 per cent. It was found also that the flue gas temperatures were abnormally high, at times reaching a value of 800 deg.

"With the type of steam boilers in use in your plant you cannot expect to approximate closely the flue gas temperatures possible with more modern boilers; however, these values should be much lower than the present average and may be expected to fall close to 500 deg., and to be somewhat lower still under certain conditions of operation.

"Fuel losses incident to these abnormally high flue gas temperatures are, of course, of considerable magnitude.

"No permanent or suitable arrangements have been made for blowing the flues with steam, consequently they are either half scraped or blown only two or three times a week and in some, of course, not that often. The result of this neglect is dirty tubes, high flue gas temperatures and loss of fuel.

"I found some of the tubes near the bottom row from ¼ to ½ full of soot and deposit at the front end. The reason for the low CO_2 percentage is excess air. The excess air enters the boiler setting through openings in the steel casing and openings in the brickwork over the combustion chamber. Some of these openings are large enough to permit an observer seeing the flames from the furnace when looking at the rear of the setting from the outside.

"Stack dampers have been provided at the uptake of each boiler, but the fireman and watch engineers do not believe in draft dampers and therefore do not use them.

"Obviously, the remedy for the above conditions is to make permanent repairs in the boiler settings, provide proper facilities for blowing the flues with steam and put the stack dampers in such shape that they may be easily and quickly operated as the changes of load may require.

"Where boilers are fired 24 hr. a day the tubes should be blown at intervals of not over 12 hr. Thermometers should be installed as a means of checking up on the flue gas temperatures, also draft gages for determining the least draft required for proper and therefore economical combustion for different loads.

"It was found that a great deal of steam is being wasted in the engine room due to leaky valves in the various steam cylinders and also due to the fact that the engines, although arranged for condensing operation, are being operated non-condensing due to leaks in exhaust piping. There is, however, another reason for

*Consulting engineer, Atlanta, Ga.

the difficulty experienced in maintaining a vacuum and that is connecting the various steam pump exhaust lines to the steam condenser; it is practically impossible to keep these pump rods and valve stems packed tight against a vacuum. This exhaust steam can be used to much better advantage by delivering it to the feed water heater. At this time the feed water is not by any means as hot as it should be due to insufficient exhaust steam being supplied to the feed water heater.

"It was noted also that the exhaust from the various steam-driven pumps in the plant, which was being led to the surface condenser through the long steam lines previously referred to, was carrying over to the condenser all of the lubricating oil used in lubricating the steam cylinders. This was because no oil separator had been provided on the exhaust line between the pump and condenser.

"The steam admission valves on the high-pressure cylinder of the large compressor as well as the steam piston, leaked badly, likewise the exhaust valves in the low-pressure cylinder were found to be leaking, caused by their being badly cut and scored. The steam and exhaust valves on the high-speed four-valve engine, which is directly connected to an electric generator, were found to be badly worn and will have to be replaced with new valves in order to insure steam tight conditions. The cages were found to be worn from 3/64 to 1/16 in., which, of course, permits steam to leak past the valves in considerable volume.

"All steam valves examined were found to be dry, indicating insufficient lubrication. To overcome the steam waste incident to the leaky valves of this unit, new valve cages and new valves should be provided. The valve gear on the steam cylinders of both the large and small ammonia compressor was found to be in a deplorable condition and will require complete overhauling, and the renewing of many of the small parts.

"Proper valve setting and therefore economical steam distribution is not possible with the valve rigging in its present shape. Considerable work will also be necessary to make the steam valves, exhaust valves and steam piston tight on each of these steam-driven compressors.

"It was noted that the pit under the generator which is directly connected to the high-speed, four-valve engine previously referred to was nearly one-half full of water and oil, and unless cleaned out this water and oil will be up over the generator leads which is very likely to result in short circuiting and burning out the machine.

"No excuse other than carelessness, laziness or indifference can be ascribed to this condition."

From another report the following paragraph relating to the boiler room is interesting.

"I have carefully examined the boiler plant and find this to be in a very bad condition. In fact, the fuel that is being wasted is tremendous and there is no excuse for the lax method followed by your engineer in the operation and maintenance of the boiler plant.

"It should be easily possible by proper operating and housekeeping to reduce the fuel cost 25 per cent and in this connection I do not know of any boiler plant that I have examined in a long time where I found the conditions as deplorable as I found them in your plant."

In another report the following paragraph discloses another case of deplorable and uncalled for conditions:

"An examination of the boiler room discloses that the larger of the two boilers installed is in a rather bad condition as regards setting and the excess air losses resulting from the vast amount of cold air entering the furnace and combustion chamber through large openings in the brickwork is enormous.

"One of the boiler feed pumps is leaking like a sieve and from all appearances is not long for this world. The entire boiler room has the appearance of being treated like a step-child and in so far as I am able to see, nobody pays any attention to what goes on in the fire room other than the negro fireman, and he don't give a damn.

"There is no question but that much fuel is being needlessly burned and that a little intelligent work on the part of the boiler room force would result in a very great saving of coal."

From a report made to the mayor and city council, covering the operation of a municipally-owned electric light, water and ice plant, the following is taken:

"As to the total station output in kilowatt-hours for any given period, say as for 24 hr., or one month, no such information is available since the recording watt-hour meter installed on the switchboard is never read and therefore no record of total station output is kept. Such laxity is not justifiable and not in accordance with good engineering practice. No record is being kept as to the fuel consumption other than by the statements rendered by the oil companies supplying the fuel oil, consequently since the daily oil consumption is not known, and since the total station output in kilowatt-hours is not known, no one knows, neither can they tell, what the fuel cost per kilowatt-hour amounts to.

"The switchboard is a monstrosity. The roof leaks badly and during rainy weather water stands in puddles in front of the board. This is a dangerous condition and might easily result in loss of life and property.

"The engine room is unkept and dirty. Tools, boards and oil litter the floor and the absence of good housekeeping methods gives one the impression of something temporary. Apparently the operators do not believe in keeping the equipment cleaned up since at the time of my inspection the machine was for the most part covered with oil and dirt which interfered with the ventilation of the electrical machinery and added to the general plant fire hazard.

"The ice-making tank is an old distilled water tank which has been changed over to the low-pressure air raw water system in recent years. I was unable to find any record of the amount of pipe in this tank and am therefore unable to predict with any degree of accuracy just how much ice could be made per day with this plant when properly operated. At present, however, the plant is not being properly operated and no daily record of ice produced is being kept. With the exception of the ammonia compressor, which is comparatively new, the physical condition of the plant is very bad.

"The safety valve on the ammonia receiver is plugged and is therefore inoperative; this is a dangerous condition and borders on criminal negligence.

Diesel Electric Power in Catalina Island

MEDIUM SIZED UNITS GIVE FLEXIBILITY OF OPERATION TO SUPPLY POWER FOR LIGHTING, MINE OPERATION, WOODWORKING PLANTS AND QUARRIES. BY O. H. BARNHILL

CATALINA Island, the popular ocean resort off the California coast, is a one-man proposition, inasmuch as it is owned and operated entirely by William Wrigley of Chicago. Formerly it was chiefly known as a fisherman's paradise and fishing is still a popular sport, with commercial fishing carried on extensively in nearby waters, but the present owner has not been content to use it merely as a pleasure resort. He is developing mineral resources and utilizing the lumber contained in its 65,000 acres of extent.

For this purpose it is necessary to have adequate supply of power and the Diesel electric plant which now has 3860 hp. capacity has grown up in response to this need.

The plant, which includes efficient central cooling, oiling and air supply systems, is arranged so that any engines may be taken out of service for inspection or

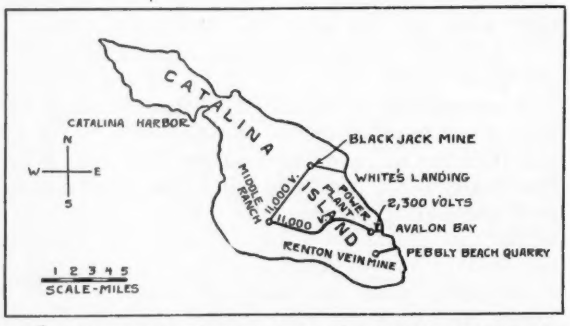


FIG. 1. SUPPLY LINES RUN FROM THE PLANT TO AVALON AND INDUSTRIAL LOCATIONS

repairs without interfering with operation. As indication of the reliability, electric current has been supplied continuously for the past 4 yr., 24 hr. a day, and 7 days a week.

Originally, the current was generated by two steam engines, a 400-kw., cross-compound, condensing unit and a 200-hp., 4-valve engine, the electricity being produced by this plant at a cost of 4½ cents per kw-hr. Records of the Diesel electric plant show that current is being generated at a total of 1½ cents per kw-hr., which includes 8 mills overhead or fixed charge. The three engines first installed at the Diesel plant had a combined capacity of 500 hp. Afterward other units of 300 hp. were added, and more recently two 360-hp. units and two 720-hp. units. At the present time, only three of the boilers are left, these being used to supply steam for the gas plant. All Diesel equipment is Fairbanks-Morse machinery, the 720-hp. engines being of airless-injection, two-cycle type.

Scavenging air is taken from an abandoned condenser pit under the floor at one end of the plant, the circulation of air through the plant, since the climate is mild, giving comfortable ventilation of the engine room.

Chief interest of the plant naturally centers about the most recent additions, the 720-hp. units. Exhaust from these passes through step elbows into lines which run straight up through the roof, one for each engine.

JACKET WATER

Since the plant is located in a canyon a mile from the island's only city, Avalon, mufflers are not needed. When these engines were added to the plant, the cooling water system was redesigned, hot water from jackets being now carried to a 15,000-gal. sump, above which are two float-controlled, 5-in., single-stage centrifugal auxiliary pumps with capacity of 900 gal. a minute against 140-ft. head. These pumps, driven by a 50-hp. motor, pick up the circulating water and force it through a 6-in. pipe to a 20-ft. cooling tower placed over one end of a 300,000-gal. reservoir, which is connected with another one of 150,000 gal. capacity near Avalon, the two affording ample fire protection to the city. Water is carried to each engine by a pipe line extending completely around the plant from the cooling sump.

Starting air equipment is located above the circulating water sump, two 2-stage belt-driven compressors, with a capacity of 20 ft. of free air a minute at 250 lb. pressure, being driven by 10-hp. motors. They are automatically controlled by Cutler-Hammer apparatus which starts the compressors when air drops below a certain pressure. Four 24 by 90-in. air storage tanks are located near the compressors, and two 30 by 90-in. tanks near the 720-hp. engines. All tanks are connected to an air line which supplies each engine with starting power.

OIL SYSTEM

Centrifuged oil is supplied from a central plant to all engines. From the engines oil drains to sumps and then into a 625-gal. storage tank placed beneath the floor from which a pipe passes to a header connected with two 150-g.p.m. Northern rotary pumps driven by 10-hp. motors. Each pump forces the used oil through a Schutte & Koerting oil cooler which cools the oil from 130 deg. to 90 deg. by means of ocean water, coming in at 60 deg. and going out at 70 deg. Outlets of the oil cooler are tied together by a header from which a pipe goes to each engine, returning the cooled oil to the lubricating system under 35 lb. pressure. Another header connects the two pump discharges so that either pump can be used with either cooler, either pump with both coolers, or each system can be operated independently. In this way inspection or repair of either oil pump or cooler can be made without disturbing operation of the system. From each cooler a 1-in. pipe leads to the centrifuges.

Wiper ring oil is drained into a 300-lb. tank from which it is delivered into the pipe leading to the centrifuging system by a 15-g.p.m. Trahern pump. Thence oil passes into two 300-gal. storage tanks, whence it is fed through two exhaust steam oil heaters to two Sharples centrifuges. From these it flows by gravity to two 300-gal. storage tanks, and is then forced by small oil pumps either to a 300-gal. elevated tank or to the 625-gal. storage tank beneath the 720-hp. engines. The smaller tank overhead for treated oil furnishes a supply for the other engines, a pipe running to each one.

Power Distribution

Power is distributed at 2300 v. to the nearer locations, including the city of Avalon, the Renton-Vein mine, rock quarry at Pebbly Beach and the lumber mill, the amount for Avalon being 1200 hp., for Renton-Vein mine 150 hp., Pebbly Beach 1100 hp., lumber mill, 100 hp. For more distant points 11,000-v. transmission is used, the line running first to Middle Ranch, which uses 400 hp., then to the Black Jack Mine, which uses 300 hp., and on to White's Landing, which calls for 350 hp.

Mines yield silver, lead and zinc, which is shipped to northern smelters, but plans are now under way for the building of an ore mill and smelter at Pebbly Beach, which will require 400 hp. additional. At present the Pebbly Beach quarry produces rock for building roads on the main land as well as on the island and furnishes large stones which are being used to extend the breakwater around Los Angeles harbor. The City of Avalon has a summer population of 20,000 and requires, besides electric power, the production of 700,000 cu. ft. of gas a day for cooking and heating.

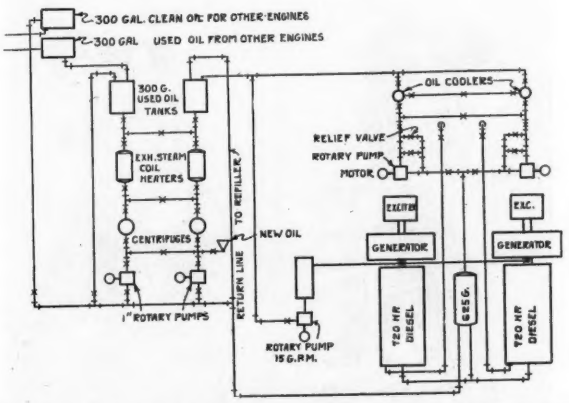


FIG. 2. LUBRICATING OIL IS COOLED AND RECLAIMED BY THIS ARRANGEMENT

Fuel consumption of the plant is 1100 gal. of fuel oil a day at a cost of 3.2 cents per gal. on the island. Oil is stored in 2500-gal. tanks and goes by gravity to the engine regulators. Night load is about 1500 hp. up to midnight and 800 to 1000 hp. from then on, the heaviest load being during the day when power is required for the industries.

While the multiple-unit plant has some drawbacks, R. A. Kilgour, chief engineer, feels that the maximum flexibility under the widely and frequently varying load makes it a desirable system for this particular installation.

The Clarksville Electric Light Improvement District No. 2, Clarksville, Ark., has started to build a new oil engine plant. Three 250-hp. Worthington solid injection oil engines will be installed. The station was designed by W. N. Gladson, Dean of Engineering at University of Arkansas. J. W. Thompson is superintendent of the plant and it will be in operation by January 15, 1928.

Too many times we say "I know" when we don't know.

Checks Favored for Payroll Payment

STUDIES in payroll procedure and personnel records by a committee of the Pacific Coast Gas Association, headed by Chairman B. H. Parkinson contains a complete discussion of the advantages and disadvantages of payment by check instead of cash.

From the employer's viewpoint, 12 favorable factors were listed, in favor of check payment. The pay check returned by the bank is an authentic record of the payment transaction, it is easy to audit, it is permanent, and can be audited at any time. It discourages theft, and padding a payroll when checks are in use necessitates a usually forged endorsement which is a more serious offense than petit larceny of cash, and usually easier to trace.

Endorsement of the check by an employe when cashing it is the best possible receipt, and eliminates receipts and receipt files. Burglary insurance on money in transit is eliminated. Life and property are protected against payroll robbery, while time and labor in transporting cash from the bank, denominating amounts and filling envelopes is a considerable item.

Disputes with employes as to amount of money found in the envelope is eliminated, as the amount of the check is definite, and is kept as a record. Earnings unclaimed by employes because of sickness or absence is more easily controlled, as cash is difficult to hold in suspense. Checks may be mailed to employes if desired, either to their home or to the bank, thus tending to promote thrift among the employes.

Cost of the pay envelopes is eliminated, and if modern methods and machinery are used in preparing the checks, the cost of preparation will be low.

Unfavorable factors are given as possibility of temporary resistance among certain employes when the system is first established, first cost of necessary equipment, and the time lost in signing checks.

Considering the large number of concerns, including all of the principal western railroads, paying by check, little weight should be assigned to the first unfavorable factor. The remaining two are well taken care of by time saving machinery, check protection and check signing equipment available.

From the employe's viewpoint, seven favorable factors to check payment are listed. If the check is lost a new one is issued, while if the cash envelope is lost there is no recourse. Shortages are eliminated and errors easily checked.

No time is wasted waiting for pay after hours and, when the checking account is used it affords an accurate record of money spent, proves payment of bills and helps save.

Unfavorable factors mentioned are: time lost in getting check cashed, which is eliminated when checks are mailed to bank by employer, need for illiterate employes to learn how to use their pay checks, and possibilities of neighbors learning income of employes when checks are cashed by neighborhood tradesmen. This is really an advantage, in that it is another incentive for employes to open bank accounts and pay their own bills by check.

Benz Diesel Engine Uses Solid Injection

PRE-COMBUSTION CHAMBER, TURBULENCE PRODUCED BY MIXING NOZZLE AND INDIVIDUAL INJECTION PUMPS ARE FEATURES OF BENZ ENGINE

SOLID INJECTION of fuel into a pre-combustion chamber of peculiar shape is a distinctive characteristic of the Chicago Pneumatic Co.-Benz Diesel engine. Fuel is delivered to and atomized through the fuel injection nozzle under 950 lb. pressure which is

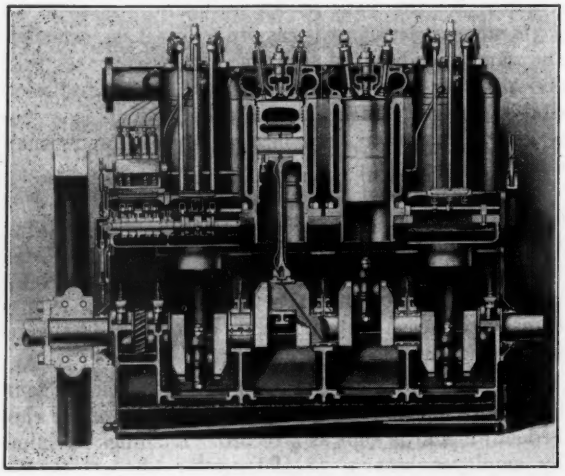


FIG. 1. CROSS SECTION OF ENGINE SHOWING RELATION OF PRE-COMBUSTION CHAMBER TO COMBUSTION CHAMBER

developed by direct acting plunger pumps, so driven as to deliver a timed charge of desired quantity. Passing through the injection nozzle this fuel is sprayed into a pre-combustion chamber in the center of the cylinder head as the piston passes over the head end center on the compression stroke. Here the atomized fuel, meeting the highly heated air of the compression, is converted into a combustible oil gas and due to the fact that the pre-combustion chamber is so proportioned as to contain only a portion of the air compressed in the cylinder, incomplete combustion takes place at this point. A rise in pressure occurs in the pre-combustion chamber and the combustible gas is driven out of the chamber through a mixing nozzle into the cylinder combustion space, where, upon meeting a fresh supply of air, complete combustion ensues at a progressive rate and pressures only slightly above compression pressures are developed.

MIXING NOZZLE PRODUCES TURBULENCE

In shape, the mixing nozzle is conical at its upper end and gradually assumes a spherical shape as its lower end is approached. Its bottom is pierced with radially disposed holes of sufficient area to produce a favorable degree of turbulence on the compression stroke, and an effective mixing of the oil gas during final compression. The mixing nozzle is closely fitted into the cylinder head and has considerable surface in contact with the water jacketed space, thus better control of the combustion period as well as prolonged life of the nozzle is secured. The injection nozzle spray is directed into the upper end of the cone shaped nozzle surface where it meets the highly turbulent air and the initial combustion stage develops. Any raw fuel settles on the combustion nozzle and subsequent out rush of gas carries it through the mixing holes vaporizing it and passing it into the cylinder combustion space. The injection nozzle is of the spring loaded valve type designed to stay closed until the line pressure is sufficient to insure atomization of the oil. The spraying process consists of passing the oil first through a swirling atomizer and then through the nozzle sprayer.

INDIVIDUAL INJECTION PUMPS ARE PROVIDED

Each engine cylinder is provided with a fuel injection pump thus assuring some power and continued operation in case of damage to any one pump. The

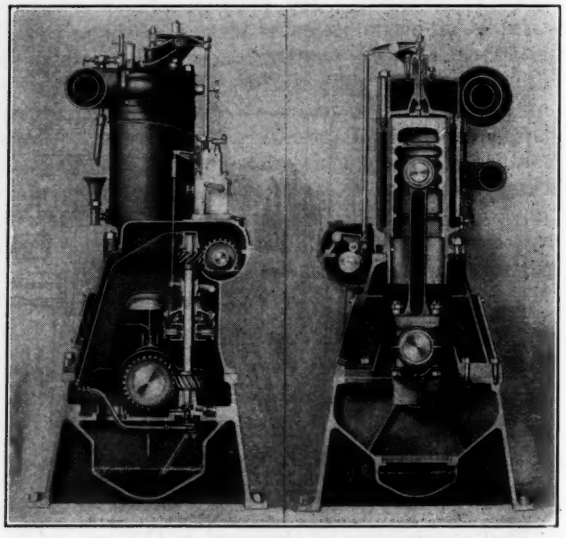


FIG. 2. CROSS SECTION OF ENGINE SHOWING METHOD OF DRIVING CAM SHAFT AND METHOD OF OPERATING INLET AND EXHAUST VALVES

fuel pump is of the plunger type and is assembled in units and mounted in banks upon a pump base. An inlet lifting screw is provided on each pump, for throwing out of operation any pump or engine cylinder for testing purposes. A pump inlet valve lifting shaft also provides means for stopping the operation of the pumps. This shaft is controlled by a linkage from the control shaft and forms the means for stopping the engine. A hand lever is provided for operating the pump to prime the fuel injection tube and nozzle and to remove the air from the pump, the tube and the nozzle.

Each pump plunger is operated by a separate cam on the cam shaft through the medium of a roller, rocker arm and tappet. The stroke of the pump and the time of injection of oil are constant for all loads. A needle valve, placed in the discharge side of the pump and operated by the governor, by-passes a portion of the oil delivered at each stroke, and regulates the charge of oil delivered to the cylinder according to the load.

This regulation occurs at the instant of injection, consequently the fuel delivered to the cylinder is proportioned to its requirements at that instant. All of the fuel injection pump needle valves are connected to a single link bar which is controlled by the governor through a linkage. The governor is mounted at the flywheel end of the frame on a vertical shaft by which motion is transmitted from the crank shaft to the cam shaft. It is of the centrifugal type, its fly weights taking the form of halved octagons which are resisted by radially disposed centripetal springs, adjustment of which is provided by means of an adjusting screw of the yoke type. Slight adjustment of speed is thus provided, if greater change is required other springs must be supplied.

Main and pin bearings are lubricated by pressure feed; pistons by splash; and all cams run in oil. Lubricant is circulated by a gear type pump, the oil pressure

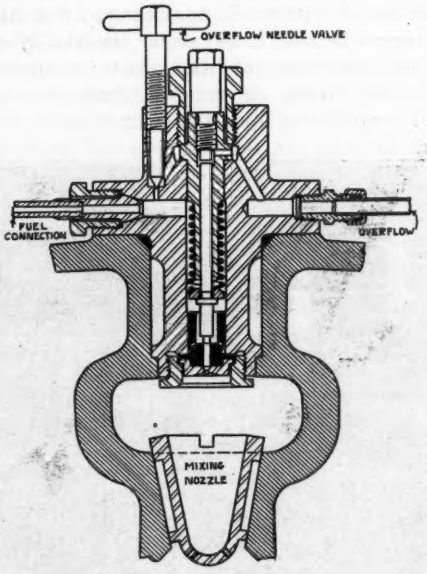


FIG. 3. INJECTION NOZZLE SHOWING RELATION WITH MIXING NOZZLE

being kept between 10 and 15 lb. and regulated by a pressure regulator which is conveniently located outside of the base. A protective feature is thus provided in that any bearing failure will be indicated at once by a drop in oil pressure. The circulating oil is passed, after use, through a filter and then through a cooling coil which is located in a cast-iron vessel through which cooling water passes. The oil cooler and filter are combined into a single assembly which may be placed on the engine room floor close to the engine.

Starting is accomplished by means of compressed air from an air chamber which is charged from the engine itself to a pressure of about 450 lb. per sq. in. by opening a charging valve which is located in the cylinder head, while the engine is running. The starting valve is of the single poppet type operated in the same manner as the inlet and exhaust valves. The roller engaging with the cam is thrown into engagement with the cam by shifting the control handle and as soon as the air is turned on, automatically keeps in operation. As soon as the engine is started the roller is shifted out of engagement.

The control handle moves the control shaft which runs parallel with the cam shaft. Mounted upon this shaft are cams for shifting into engagement the air starter cam rollers and cams for lifting the exhaust valves and a link arm connected to the fuel pump is provided to control the charge of fuel at starting.

Accessibility Is Ample

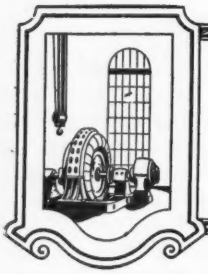
Large frame doors on each side of the engine give access to the main bearings, crankpin bearings and governor mechanism. Main bearings, which are of the cylindrical shell type, can be removed while the shaft is in place and end covers over the main bearings permit of removal of the crankshaft without removing the frame from the base. Cam shaft and cams are made accessible by removing the cam shaft covers which are in sections. Push rods are of the ball-end type and can be instantly removed. Any fuel pump can be thrown out of action and removed bodily without stopping the engine.

An unusual conversion feature is incorporated in the design of the engine in that parts for changing an oil engine into a gas engine are available at moderate cost. This feature is of especial importance in connection with gas compressor units in which engine and compressor have been combined into an integral unit but where conversion into an oil engine drive is anticipated.

This engine, which is intended for small general power purposes and isolated or small power plant drives and as a stand-by unit in larger power stations, is built with two, three, four or six cylinders and rated respectively at 80, 120, 160 and 240 b.hp. at 327 r.p.m. It is of the four-cycle, high compression, single acting type.

The Sao Paulo Tramway, Light & Power Co., Sao Paulo, Brazil, has approved plans for a new hydroelectric plant near the city and will proceed with construction at an early date. This plant will have an ultimate capacity of about 80,000 hp. The State Department, Rio Grande do Sul, Port Alegre, has tentative plans for a new hydroelectric plant on the Jacuhy River also with an initial capacity of about 80,000 hp. This station will be used largely for light, heat and power service at Port Alegre and vicinity. The Rio de Janeiro Tramway, Light & Power Co., Rio de Janeiro, has recently completed the first unit of a new hydroelectric generating station on the Parahiba River with a capacity of 50,000 hp. The plant site has an estimated potential capacity of more than 200,000 hp.

What is claimed to be the first completely electrically welded Cornish boiler without any riveting has recently been completed by the Swiss Locomotive and Machine Works of Winterthur, Switzerland, for a Swiss tannery. The boiler which has a heating surface of 430 sq. ft. is intended for a working pressure of 185 lb. per sq. in. The pipes were arc welded, the longitudinal seams being reenforced on both sides by Hoehn-type butt joints.



ELECTRICAL MACHINERY FOR LIGHT AND POWER

An Oil Circuit Breaker for Heavy Duty

NEW FULL AUTOMATIC CIRCUIT BREAKER FOR POWER PLANT SERVICE CAN BE SHIPPED WITHOUT DISMANTLING. BY E. K. REED*

WITH THE CONTINUED progress in the use of electricity for all purposes, the requirements of users of all electrical apparatus are constantly changing. Better performance and service of the apparatus is demanded. Circuit breakers are no exception to this rule. Operating men are constantly requiring improvements in apparatus so that they may receive better performance, apparatus easier to maintain and which will perform a greater number of functions.

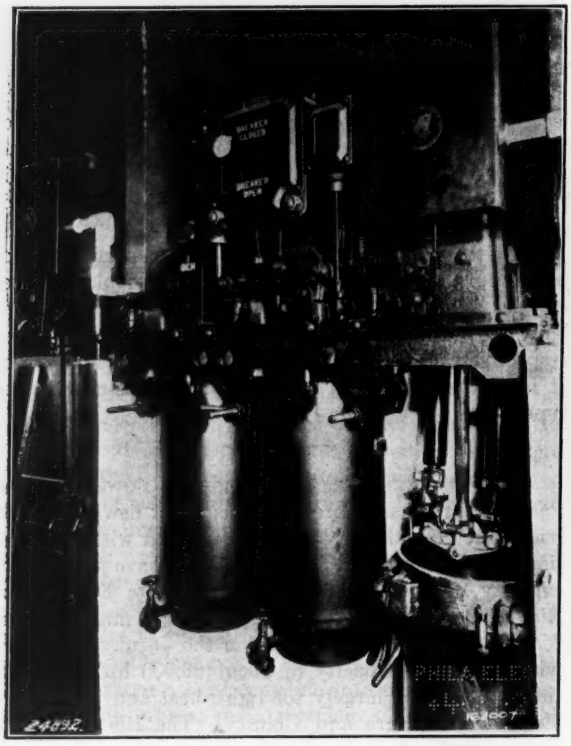


FIG. 1. A VIEW OF THE CIRCUIT BREAKER SHOWING THE OIL TANKS, ONE OF WHICH HAS BEEN LOWERED TO SHOW CONTACTS

In the accompanying photographs are shown views of a circuit breaker designed for power house use which is to be mounted in a cell structure, to give the maximum performance at a minimum expense. The circuit breaker is designed so that it can be built, tested and shipped without dismantling. A minimum of work is required for installation because of this feature.

This circuit breaker is mechanically full automatic, i.e., it cannot be held closed either electrically or manually if any abnormal condition exists in the controlled circuit. All energy is removed from the operating solenoid immediately upon the completion of the closing stroke of the circuit breaker and the control circuits are protected in an unusual degree to prevent, insofar as possible, any failure on their part. Barriers are provided to prevent accidental contact with the main conductors. A pointer placed in a conspicuous position indicates whether the breaker is open or closed. The breaker is made so that a mechanism for the operation of the disconnecting switches can be added. This mechanism interlocks with the circuit breaker mechanism so that the disconnecting switches cannot be opened or closed unless the circuit breaker is open, nor can the circuit breaker be closed unless the disconnecting switches are completely open or closed.

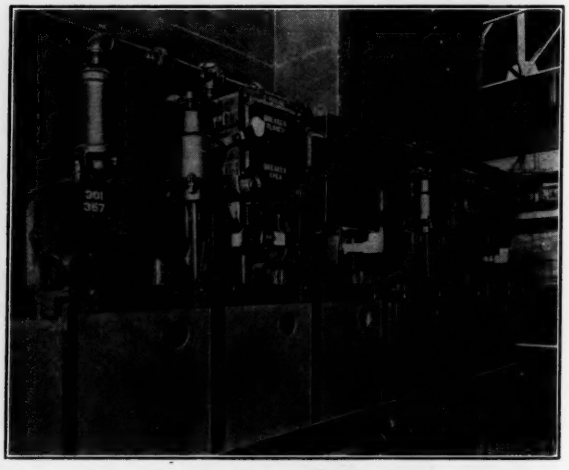


FIG. 2. AN INSTALLATION OF HEAVY DUTY BREAKERS IN A LARGE CENTRAL STATION

The main base forms a foundation for the entire circuit breaker, the base being supported on inserts built into the structure walls. The base has domed tops over each pole unit in which the pole unit operating mechanism is placed. A rotating shaft passing through the side of the domed top operates the pole unit mech-

*Circuit Breaker Engineering Department, Westinghouse Electric and Manufacturing Co.

anism. There is no other opening in the mechanism housing through which oil or gas can be expelled during the operation of the circuit breaker. A straight line mechanism raises and lowers the contacts. The parts of this mechanism are kept well up away from the live parts and the space where the circuit is broken.

High quality insulating oil surrounds the contacts and helps to extinguish the arc on opening the circuit. A strong tank securely held in place is provided to retain the oil. The tank can be easily removed for inspection or maintenance of the contacts. The tank is provided with an insulating, arc-resisting lining which insures proper protection of the tank over a long period.

The operating solenoid is bolted to the front of the dome of the middle pole breaker unit. The mounting is so designed that the operating solenoid can be removed and replaced without disturbing the operating linkage or the adjustment of the circuit breaker. Covers are provided for the operating mechanism so that the coils are entirely enclosed in metal. The closing coil leads leave the operating mechanism through conduits which connect the mechanism and the control relay panel housing.

Leads from the main circuit are brought into the circuit breaker through condenser terminal bushings. The bushings have clamps which bolt securely to the under side of the main base. The pressure of the contacts is therefore taken directly by the base, the bolts serving only to hold the bushing in place. This type of bushing is exceedingly durable and dependable in that it is not subject to fractures caused by the sudden stresses of short circuit currents or by accidental contact of tools in the hands of the construction or maintenance force. The design of the condenser bushing insures uniform distribution of the voltage stress throughout the bushing.

The main contacts consist of "U" shaped punchings so placed that each individual lamination makes contact with the contact feet placed on the lower end of the bushings. Each lamination, therefore, carries its part of the current from one conductor across to the other conductor. This insures good distribution of the current and minimum resistance throughout the conducting path. The punchings are arranged in two groups so as to provide two parallel paths for the current. Flexibility of the laminations is obtained by slanting the upper or contact ends of the punchings away from each other. When the contact is drawn to the closed position, the groups of laminations engage the contact foot and move laterally across the face of the foot away from each other. The reaction of the currents flowing in the same direction in the parallel paths is such that the flexible laminations are drawn towards each other by a force proportional to the current.

Finger type arcing contacts protect the main contact by opening after the main contacts are well cleared. The finger contacts are placed well out away from the main contacts to secure the maximum advantage to be obtained by the "blow out" effect of the current. The finger contacts are comparatively inexpensive and arranged for easy replacement when worn out in service.

The control relay panel carries a full automatic relay, safety knife switch, auxiliary switch for interlocking and indicating lamps, and terminal studs to receive the wires from the control board. The panel is mounted in a box which covers the rear of the panel and protects all of the exposed conductors from any possibility of damage or short circuit. A cover for the front of the panel is provided which is easy to remove and replace.

When the control switch on the switchboard is moved to the proper position for closing the circuit breaker the control relay is closed by its closing coil. The circuit breaker is then closed by the circuit breaker closing coil. Immediately the circuit breaker reaches the closed position, the auxiliary switch, also mounted on the control relay panel, makes contact and energizes the release coil of the control relay. This trips the trigger opening the relay contacts while the armature is retained by the relay closing coil. The control relay contacts cannot be reclosed until the operator at the switchboard returns

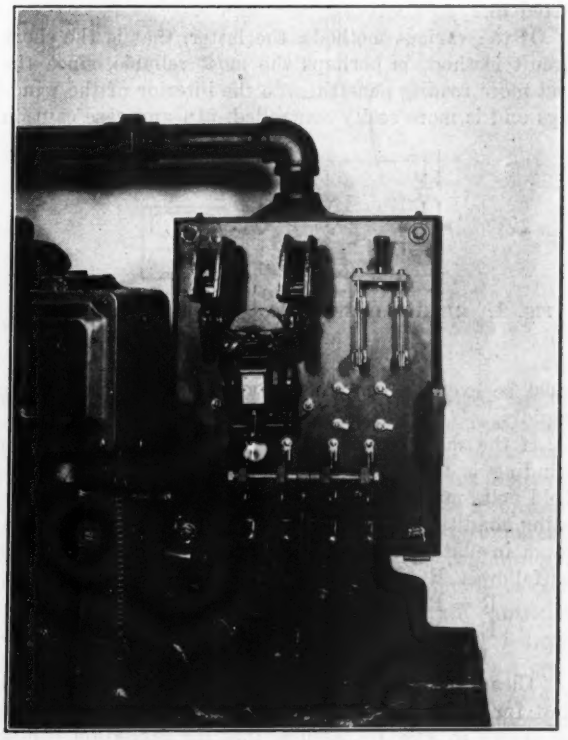


FIG. 3. CONTROL RELAY PANEL WITH COVER REMOVED

the control switch to the off position, de-energizing the operating coil, the armature falling to the open position, the latch reconnecting the armature with the contact arm, and then re-energizes the relay closing coil. Thus the circuit breaker is absolutely prevented from "pumping" if it is tripped out by any abnormal condition in the controlled circuit, while the control switch is held in the "close" position.

EQUIVALENT EVAPORATIVE rates slightly under 14 lb. of steam per sq. ft. of surface maintained for from ½ to 2 hr. have been reported by five member companies of the N. E. L. A. One company reports an equivalent evaporation of 21 lb. per sq. ft. for 1 hr. period. This company also reports a repeatedly maintained rate of about 20 lb. equivalent from 6 to 8 hr.

Procedure in Starting Up a New Generator

PART II. METHODS OF DRYING OUT THE WINDINGS TO REMOVE MOISTURE. BY MARIN PHILLIPS

IF THE INSULATION resistance of a generator is found to be below the safe standard as determined by the A. I. E. E. rules it must be brought up to a safe value before building up the voltage by drying out the windings. This is accomplished by the application of heat.

It is in the application of this heat to various sizes of electrical machines that the technique varies. With small generators, and where the equipment is available, the entire machine may be placed inside an oven. With large units, hot air may be blown through the windings or heaters may be arranged inside or on the outside of the machine, or the short circuit method may be resorted to.

Of the various methods, the latter, that is the short circuit method, is perhaps the most reliable, since the heat more readily penetrates to the interior of the windings and is more easily controlled. In any case caution

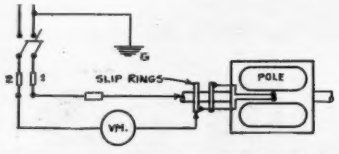


FIG. 1. METHOD OF TESTING FIELD POLE INSULATION RESISTANCE

must be exercised not to apply too much heat nor too rapidly.

If the short circuit method of drying out the stator winding is to be used, the insulation resistance of the field poles must be tested first to see if they are in operating condition. A well known formula gives the minimum insulation resistance for direct current generator as follows: $R = E\ (300{,}000 \div I) + 150{,}000$

R = Resistance in ohms of the insulation.
E = Normal rated voltage of generator.
I = Normal rated current of generator.

Clean the rotor and field coils well and apply the test for determining the insulation resistance to ground as shown in Fig. 1. Assume that the excitation voltage for the field coils is 250, and that it takes a charging current of 25 amp. Then $R = \left(\frac{300{,}000}{25} \times 250\right) + 150{,}000 = 3$ megohms. If the test shown in Fig. 1 shows that the field pole windings have an insulation resistance of 3 megohms, they can be excited for furnishing the field to build up the short circuit current in the stator winding for drying it. But if the test shows the field coils to have a lower insulation value they also must be dried out before putting them into service.

Figure 2 shows the connections for the short circuit drying out heat run. The short circuit is made on the generator side of the main oil circuit breaker, which can be done by putting on jumpers, or the cables may be disconnected from the oil switch and bolted together, which is probably the best procedure as it will prevent the possibility of the oil switch being accidentally closed on the short circuited cables. The current transformers and ammeters are connected into the generator leads between the point of short circuit and generator winding. When making the short circuit test, it will be a safe precaution not to have the oil circuit breaker or any other automatic switch in circuit for the short circuiting device. There is always the possibility of the switch being accidentally tripped open, which would cause a sudden rise in voltage that might prove disastrous to the winding. If there is a set of disconnect switches in the leads between the generator and the oil switch, the cables can be taken loose on the oil switch side of them and the short circuit applied across the disconnect studs.

The amount of current that must flow in the stator winding while the drying out is in process, will depend largely on the general design of the generator, as to its rating, whether liberal or closely rated, its ability to carry off heat and the surrounding temperature. Some of the old makes of generators were liberally designed and would safely carry a considerably larger current than their normal full load without overheating. Present day machines are maximum rated and will not carry this excess overload without overheating. When the short circuit is applied and the generator is ready to start, it should be started very slowly and a weak field applied. The current transformers and ammeters should be calibrated accurately and must be known to register correctly. When the generator has started turning over slowly with a weak field, the ammeters must be watched closely. It will be a safe plan not to allow the short circuit current to increase above fifty per cent full load current at first, by cutting out resistance in the field and increasing the speed of generator. The short circuit current can be raised slowly as the winding warms up, watching the heating carefully. Caution must be used during this warming up not to permit the actual temperature to go over 90 deg. C. The inside and bottom of the coils will be hotter than the outside where the thermometer will be placed for measuring the temperature and allowance made for it. If the outside of coils have a temperature of 90 deg. C., the inside will be overheated. It is safe to assume that the temperature inside of the coils will be 15 deg. hotter than the outside, which means that the temperature as taken on the outside should not rise above 75 deg. C.

USE OF EMBEDDED TEMPERATURE DETECTORS

Some generators, especially turbine driven, will have temperature coils embedded in the bottom of the coil slots at several places which always indicate the temperature of the hottest part of the winding. If the generator has these coils which are known to register correctly, then the temperature can be allowed to reach 90 deg. as indicated. Outside thermometers can be used as a check if desired. If no temperature coils are provided, then thermometers must be used by so locating them that the bulbs will bear against the coils. These can best be held in place by the use of friction tape

or putty. On generators of the inclosed type such as turbo-generators it will be necessary to remove some of the end shields in order to place the thermometers so they can be read while the heating is in process.

The time required for drying out and the short circuit current needed will depend on the temperature of the surrounding air. The drying out of the winding can be hastened by protecting it from the surrounding air if it is cool, by the use of baffles or canvas covers.

A certain amount of air circulation will have to be maintained through the winding during the drying out period. The best way to secure this circulation is to have it enter through the bottom of the winding and leave through the top. If the surrounding air temperature is very low or damp it is good practice to heat the air slightly before delivering it to the winding. This can be accomplished by directing the flow of air to the winding through a duct formed by canvas or a large piece of sheet metal pipe and a stove or electric heaters placed so that the ingoing air will have to pass over them. Some types of machines, especially turbo-generators, have their windings so designed that there will be a large amperage per slot.

Great caution must be exercised when drying out this type of generator because of the excessive heating of some of the slots at the ends of the armature core. These will usually be found to exist in the first few stator iron laminations and are most pronounced between phase intersections. This end heating is much greater when operating with a short circuit than it is under a full load. This condition is brought about by the frequency and is controlled by the speed of the generator. Best results will be obtained if the drying out is effected with the generator running at about one-third to one-half full speed. Under no circumstances allow the speed to exceed one-half full speed. If this procedure is not carried out carefully, there is a possibility of burning the coils and wedges caused by the heating of the end laminations without any indication from the temperature coils that excessive heating exists. This heating of the end slots occurs only in high speed machines having a high current rating per slot. The ordinary run of slow speed generators will have sufficient slots for their rating to eliminate this danger. It is impossible to give a set of hard and fast rules for drying out that will apply to all types and different ratings of generators. Each machine will have its own best way for the drying out procedure and it will be necessary to use judgment in deciding upon any particular method.

The insulation resistance and condition of a generator are dependent upon the amount of moisture present in the windings. It should be remembered that the small resistance value of 1.77 megohms is only the minimum insulation resistance; that is, when the insulation resistance falls below this value, the generator should be dried out. This is calculated to be a minimum safe value, which means that the drying out process must not be stopped when this value is reached.

One formula that is given and easy to remember is that the insulation resistance of an alternating current generator in megohms should not be less than three times rated normal voltage at the terminals, divided by the rated capacity in kv.a. when cold. If we apply this formula to our generator in question we will find that its resistance in megohms when cold should equal $\frac{3 \times 2300}{300} = 23$. The rate that the insulation resistance of the generator changes, is the best indication to go by in order to tell when the drying out process has been carried far enough.

Things to Watch During Drying Out Process

When all is ready to start the drying out of the winding, measure the insulation resistance with the megger, if one is available; if not, then use the voltmeter method attached to the direct current test circuit as already described.

While the drying out process is going on, it will be well to measure the insulation resistance every 8 or 10 hr. so the progress of drying out can be followed. It will be noticed that the insulation resistance at first will decrease, due to the rise in temperature as the winding warms up; however, no alarm should be felt as this is due to the specific resistance of the insulation. The resistance will decrease to its minimum value during the time the winding increases to a constant temperature. When the winding has settled down to a constant temperature, the insulation resistance will start increasing as the drying is carried out. At the beginning it will increase extremely fast; but as the drying is continued, it will increase at a lower rate until it reaches a maximum value, which may take 3 or 4 days, depending on the amount of moisture present. In generators that have been well water-soaked, it may take a considerably longer time. While the drying out is in progress, it is necessary to watch the drying closely so as to know when the moisture has been driven off, for a prolonged drying out is undesirable as it takes unnecessary time and energy. If the operation is continued after the moisture has been driven off, it will promote oxidation and deterioration in the insulating materials which will result in shortening the life of the generator winding. This is why the measuring of the insulating resistance from time to time is necessary as the drying out proceeds. It is desirable to have as high a resistance value as it is possible to get, how high a value can be obtained will depend on the general condition of the winding insulation as to dirt, age and whether it has started to deteriorate or not. The drying process should be continued as long as the insulation resistance keeps increasing, if possible. When the insulation resistance has been steady and has not increased for 12 or 18 hr., with other conditions favorable, it will be safe to stop the drying out process.

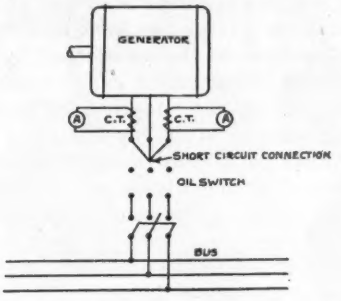


FIG. 2. CONNECTIONS FOR DRYING OUT GENERATOR BY THE SHORT CIRCUIT RUN METHOD

Procedure for Testing Dielectric Strength of Insulating Oils

IMPORTANCE OF HIGH DIELECTRIC STRENGTH IN OIL INSULATING MAKES A STANDARD METHOD OF TEST DESIRABLE

INSULATING OILS are used in connection with a large share of electrical apparatus and since the safety and proper operation of this apparatus is dependent upon the good condition of these oils, it is highly necessary to know how to test them periodically. Of the various tests, the dielectric strength test is perhaps the most important. In a recent report of Committee D-9 on Electrical Insulating Materials of the American Society for Testing Materials, methods for making all kinds of tests of insulating oils are described and the following method for making the dielectric test is abstracted from that report.

The test cup for holding the sample of oil shall be made of a material having a suitable dielectric strength. It must be insoluble in and unattacked by mineral oil and gasoline and non-absorbent as far as moisture, mineral oil and gasoline are concerned. The electrodes in the test cup between which the sample is tested shall be circular disks of polished brass or copper, one inch in diameter and having square edges. The electrodes shall be mounted in the test cup having their axes horizontal and coincident, with a gap of 0.1 in. between their adjacent faces, and with top of electrodes about 33 mm. (1¼ in.) below the top of the cup.

(a) The electrodes and the test cup shall be wiped clean with dry calendered tissue paper or with a clean, dry chamois skin and thoroughly rinsed with oil-free dry gasoline until they are entirely free from fibers.

(b) The spacing of electrodes shall be checked with a standard round gage having a diameter of 0.100 in. and the electrodes then locked in position. Care shall be taken not to touch the electrodes with the gage or in any other manner after cleaning the electrodes and cup, so as to avoid any possible contamination.

(c) The test cup shall be filled with dry gasoline, and voltage applied with uniform increase at the rate of approximately 3 kv. (rms) per second until breakdown occurs. If the dielectric strength is not less than 25 kv., the cup shall be considered in suitable condition for testing the oil. If a lower test value is obtained the cup shall be cleaned with gasoline[1] and the test repeated.

(d) The temperature of the oil when tested shall be the same as that of the room which should be between 20 and 30 deg. C. (68 and 86 deg. F.) Testing at lower temperatures is likely to give variable results which may be misleading.

(e) The sample in the container shall be shaken so as to mix the oil thoroughly before filling the test cup. This is even more important with used than with new oil as the impurities may settle to the bottom and the test may be misleading.

(f) The cup shall be filed with oil to a height of not less than 20 mm. (0.787 in.) above the top of the electrodes.

[1]Evaporation of gasoline from the electrodes may chill them sufficiently to cause moisture to condense on their surface. For this reason, after the final rinsing with gasoline, the test cup should be immediately filled with the oil which is being tested and the test proceeded with at once, or the electrodes should be thoroughly dried.

(g) The oil shall be gently agitated by rocking the cup and then the oil shall be allowed to stand in the cup for three minutes before the first and one minute before each succeeding puncture. This will allow air bubbles to escape.

(h) Voltage shall be applied and increased uniformly at a rate of approximately 3 kv. (rms) per second until breakdown occurs as indicated by a continuous discharge across the gap. (Occasional momentary discharges which do not result in a permanent arc may occur; these should be disregarded.)

(i) Provision shall be made for opening the circuit as promptly as possible after the breakdown has occurred in order to prevent unnecessary carbonization of the oil. After each puncture, the testing vessel shall be jarred to loosen particles of carbon adhering to the electrodes and the oil gently agitated but not with sufficient violence to introduce air bubbles.

(j) Five breakdowns shall be made on each filling after which the vessel shall be emptied and refilled with fresh oil from the original sample. The test shall be continued until the averaged value of at least three fillings do not differ from their mean by more than 10 per cent.

(k) The last filling of the cup should drain the container. If a quart sample be received, allowance shall be made in withdrawing portions so that just enough be left for a final filling of the cup with the draining from the container.

The report shall include the following:

(a) The volts (rms. value) at each puncture, the average voltage for each of the three or more fillings and the grand average.

(b) The report shall be stated as kv., 1.0 in. disk, 0.1 in. gap.

(c) The approximate temperature of the oil at the time of the test.

DEGREE OF PRECISION POSSIBLE

A precision of about 3 per cent may reasonably be expected in 15 tests distributed among three consistent fillings taken in succession. But if the length of the gap is readjusted and possibilities of contamination exist, the precision may be only 6 or 7 per cent. Differences as great as 10 or 12 per cent may occur between different laboratories even where the work is carefully done.

"DURING THE PAST 12 yr.," said Harry Guilbert of the Bureau of Safety & Welfare at The Pullman Co., "I have tried every conceivable method known to human ingenuity to get men to wear goggles, such as spectacular bulletins, horrible examples, pleading and threatening, promulgated rules and regulations which are useless unless they are enforced; in fact, everything along persuasive and educational lines, with very small results and often none at all. It is my firm conviction that the goal for which we are striving will never be attained until a mandatory ruling is issued to the effect that every employe in the shop must wear goggles while on duty. This rule is enforced in the shops of the Pullman Company and is the reason why goggles are worn universally."

Museum Plans Steam Power Plant Exhibit

SMITHSONIAN INSTITUTE WILL DEVOTE SPACE TO FORM PERMANENT DISPLAY ILLUSTRATING DEVELOPMENT OF STEAM POWER INDUSTRY

ENTIRELY too little is known about the early steps taken to use the expansive force of steam to relieve the human race and beasts of burden from labors which today are so much better accomplished by machinery. The public libraries have their books of history and biographies that tell the story very thoroughly, but these books on their shelves lack the spectacular appeal necessary to attract and hold the interest of the general public. For this it is recognized that the museum occupies a field all its own and during the past few years quite an interest has been aroused among men of the industry in the establishment of a museum which would trace the development of power from its very beginnings to present practice. The answer to this interest comes from the Smithsonian Institute whose acting secretary has authorized the Division of Mineral and Mechanical Technology of the National Museum to proceed with the development of a single unit of a steam power plant engineering museum in accordance with the best modern museum practice. The selection of this subject was influenced by the existence of quite a collection of early steam engine material and the apparent lack of public appreciation of the importance of this branch of engineering.

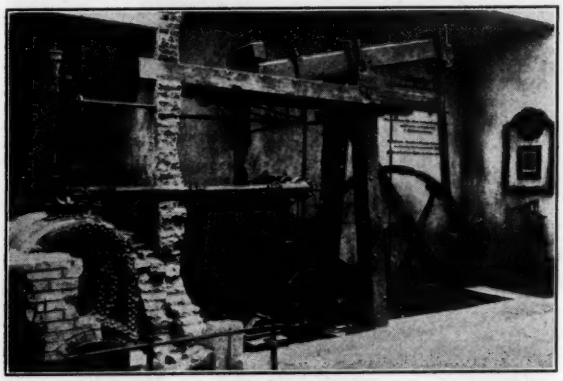


FIG. 1. FULL SIZE WATT ENGINE WITH SUN AND PLANET GEARING AS PRESERVED IN THE DEUTSCHES MUSEUM, MUNICH, GERMANY

Forty years have passed since the organization of the industrial and engineering sections of the United States National Museum in Washington and during that time nearly every branch of industry and engineering has brought to light equipment and information that have continuously expanded the collections in the Museum. These have been inadequately displayed, due to lack of space and insufficient personnel, but within the next few months 3000 sq. ft. of floor space with 14½ ft. ceiling height will be made available for this new undertaking which will be limited to the presentation only of the most significant steps of development.

Treatment of the subject will be carried out along two lines, namely, its history and modern practice. For the early historical part it will be necessary to construct a series of models illustrating the progress made from the toylike turbines of the ancients to the engines of Newcomen and Watt. Hero's aelopile, Branca's impulse turbine, DeCaus' steam fountain, Savery's pulsometer, Papin's cylinder and piston and Newcomen's atmospheric engine are to be constructed in miniature and exhibited with related manuscripts, translations, engravings and drawings. One of Watt's original engines will be exhibited if it can be procured; if not, a restoration will be used. To complete the pre-American history, models of boilers of the 17th and 18th centuries will be exhibited.

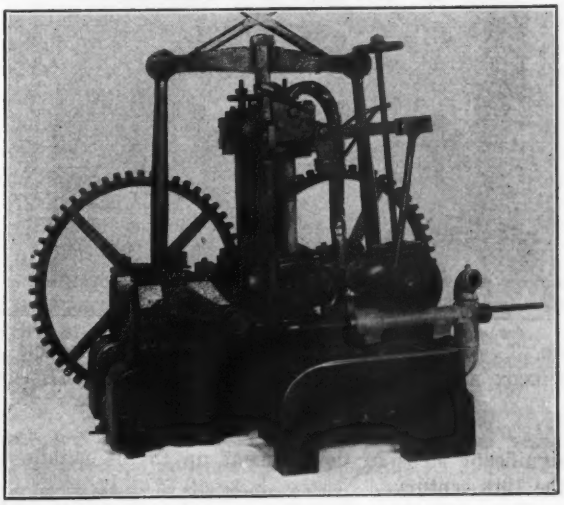


FIG. 2. JOHN STEVENS' STEAMBOAT ENGINE OF 1803

Not until after 1755 did purely American developments begin, when the steam engine was first introduced in America by Josiah Hornblower, and from this date the exhibit will be confined to the significant steps of American developments. The Museum has the only remaining relic of Hornblower's engine, namely, a section of the cylinder, and it is planned to exhibit with this relic a miniature restoration of the engine on its original location. Unfortunately nothing illustrative of the early developments in this country between 1755 and 1803 is available, yet this period should be represented. James Watt sold several engines to purchasers in New England during this time, and Oliver Evans, our own pioneer steam engine builder, had by 1815 constructed some 50 engines. Evans is credited with being the first to make a compact high-pressure engine cheap enough for practical use, and ranging from 10 to 25 hp. His engines were in use in Providence, Pittsburgh, Marietta, Philadelphia, as well as in the States of Florida, Louisiana and Mississippi. Furthermore, Stackhouse and Rogers built engines at Pittsburgh under his patent, and, lastly, Evans built and erected in 1817 the engine and boilers for the Fairmount Water Works in Philadelphia. Following Evans, the work of John Stevens of Hoboken and Nicholas Roosevelt of New York is to be represented, as well as other

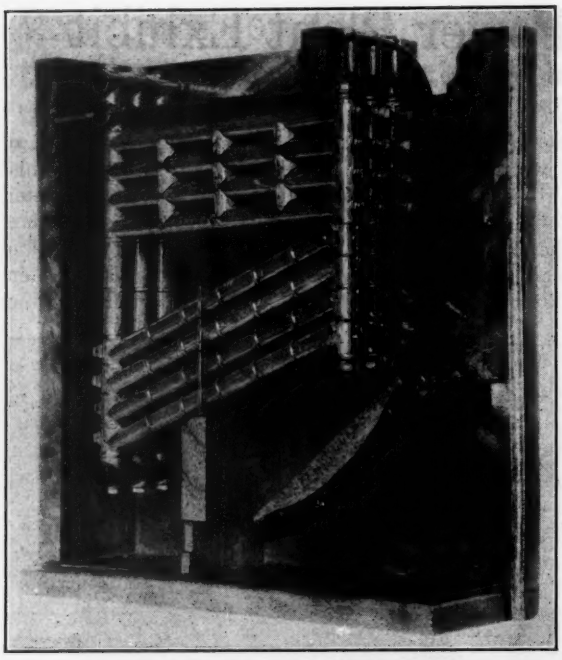


FIG. 3. ORIGINAL PATENT OFFICE MODEL OF BABCOCK & WILCOX BOILER FOR PATENT 65,042, MAY 28, 1867, PRESERVED IN NATIONAL MUSEUM

significant steps of development up to the middle of the 19th century.

From this date on, it is proposed to divide the subject into the separate developments in design of boilers and engines. In each case three or four steps are to be selected to show the salient features of American practice for that period. For example, it is hoped to include a horizontal engine of the slow speed, mill-driving type of about 1830, and a small Corliss engine of as early a date as may be in existence. In the boiler group it is proposed to have represented one or two early water tube designs prior to the standard inclined tube type, featuring those developed by Stephen Wilcox and the Stevens, father and son. Some space will then be devoted to a sketchy presentation of the thermodynamics of boilers and engines to show by models, indicator cards, diagrams and tables just what the problems of the industry are and to indicate the reason behind the developments and improvements as shown.

Modern practice will occupy the last part of the proposed exhibit. Steam power plant engineering will be presented as an industry using fuel as a raw material and producing power as a finished product. Fuel and ash-handling equipment, turbine room, condensers, boilers, draft equipment, etc., will be represented by models and full size objects when possible.

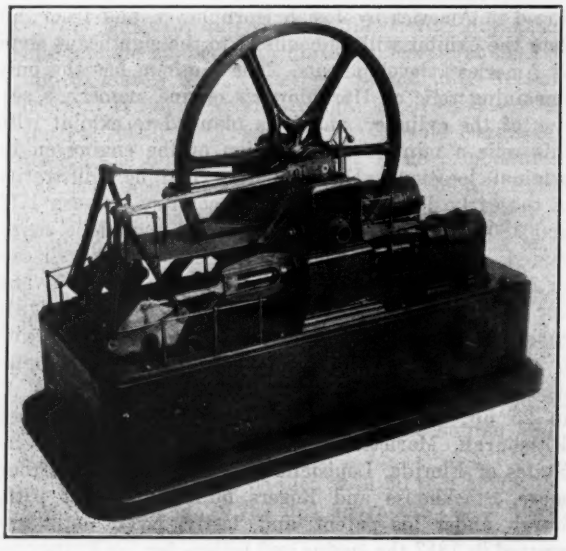


FIG. 4. ORIGINAL PATENT MODEL OF CORLISS PUMPING ENGINE FOR PATENT 215,803, MAY 27, 1879, PRESERVED IN THE NATIONAL MUSEUM

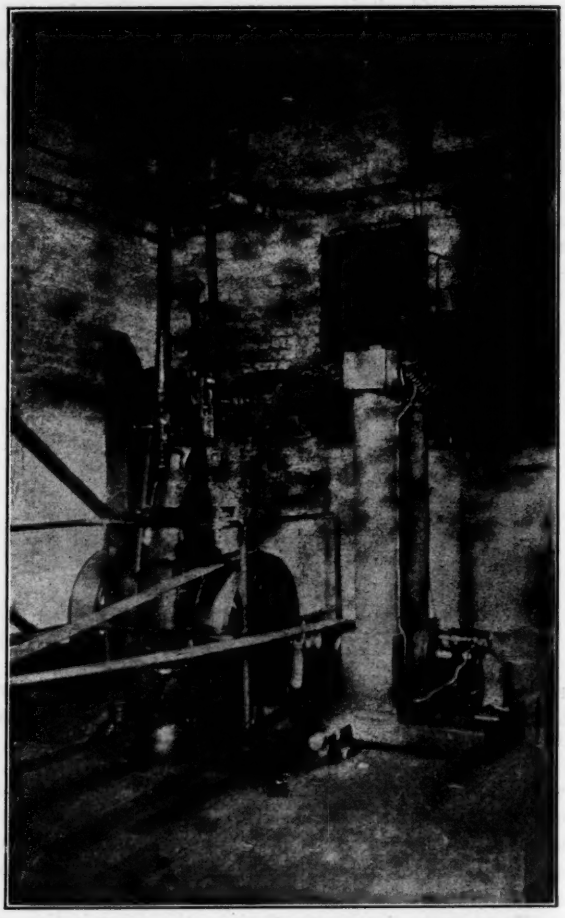


FIG. 5. EDISON'S FIRST COMMERCIAL INCANDESCENT LAMP INSTALLATION ON LAND MADE IN 1881. CONTEMPORARY DYNAMO PRESERVED IN THE NATIONAL MUSEUM

The Museum would like to have information of any sort relative to the engines of Watt, Evans and Roosevelt; information as to the existence of any steam engines earlier than 1830; of an early Corliss; and of early types of steam engine and boiler equipment. The Museum would like to have information regarding appropriate exhibition material for both the historic and modern parts of the proposed exhibit.

Notes on the Use of Flexible Metallic Gaskets

By W. F. Schaphorst

MANUFACTURERS OF GASKETS have for many years been striving to make gaskets of metal and at the same time to make them elastic. As a result, the combination asbestos-metallic gasket has appeared and in the writer's opinion seems to have solved the problem quite satisfactorily. This type of gasket takes care of expansion, is tight, is not in the least spongy or porous, yet is elastic.

It has been found that by winding layers of asbestos between layers of metal, an excellent flexible type of gasket is the result. One gasket which the writer measured had a face value of 86.7 per cent asbestos and 13.3 per cent steel. This type of gasket does not make purely metal-to-metal contact. The asbestos area touching the flanges is 6.5 times as great as the metallic contact which is an important feature.

In considering the method of using gaskets, it should be pointed out that a good gasket should not stick to flanges on removal and it should not be necessary to coat it with graphite or anything else to keep it from sticking. At the same time, however, substances such as graphite, cement, paint or oil should not be harmful. There should be nothing delicate about gaskets that are used on boilers and if an engineer wants to use graphite, let him.

Flexible-metallic gaskets should not be screwed up tight. The prevalent idea seems to be that all gaskets, in order to prevent leakage, must have as little thickness as possible and must be squeezed so thin that the distance between the faces of the flanges is a very close approach to absolute zero.

Often when applying gaskets we see the engineer or pipe fitter slip a pipe over the wrench, thereby increasing the wrench's leverage and making it possible to still further increase the pressure against the gasket. As a result the gasket is squashed, the elastic limit of the metal of which the gasket is made is passed, the gasket is flattened out, and the original elasticity can do no good whatever. It is poor practice to slip a pipe over any wrench on any gasket because wrenches are generally made of a proper and safe length to fit the nut for which it was intended, and nut sizes are usually standardized to fit certain bolt diameters. This is a logical safety measure that has been almost universally adopted so that the bolt will not be subjected to too great tension. An extra long handled wrench, unless used with extreme care, is liable either to break the bolt or strip the threads.

Necessity for Taking Care of Expansion

One serious objection to the very thin gasket is that no matter how it is constructed it can have but little expanding or contracting capacity, consequently all expansion and contraction must be taken care of in some other manner. A thicker gasket, having elastic properties, will naturally take care of considerable expansion and contraction.

Where temperatures are high, or where temperatures fluctuate considerably, copper, brass and other metallic gaskets having a coefficient of expansion different than that of the joint, should be avoided if possible. On account of the difference in the coefficient, the gasket and the joint tend to expand and contract independently of each other. The tightly bolted joint being much stronger than the thin gasket will compel the gasket to expand and contract along with it. Breakage and leakage of a serious nature are therefore often the result. A gasket made up of steel which has the same coefficient of expansion as the joint, overcomes this latter trouble entirely, but if it is thin and nonflexible it does not overcome or assist in overcoming the longitudinal expansion troubles.

Hence when applying this type of thick flexible metallic gasket, be certain that a wrench of the correct length is used and then tighten only enough so that leakage is prevented. Do not tighten too tight. Any further tightening after leakage is stopped simply reduces the elasticity of the gasket and does not give it an opportunity to "breathe" as it should simultaneously with the change in pressure of the boiler.

Order Gaskets by Means of a Template

When ordering boiler gaskets, it always is a good plan to send a template. A template is a pattern or die made of paper or other material. Thus, if the type or size of the gasket is odd or unusual, the manufacturer will have no difficulty in making the exact size and shape. There is nothing better than a template giving these necessary details. If made of paper, folded, placed in an envelope and mailed, the conditions will be made perfectly clear to the manufacturer and he will be able to serve you promptly.

Water-tube boiler manholes and tube caps are standardized, hence in such cases it is necessary to give only the name of the boiler and the quantity wanted. Templates are not necessary.

Finally, here is a kink: When it is desired to use a gasket oftener than once, it is advantageous to place it in "exactly the same position" every time. This is particularly true on boiler tube caps and boiler manholes.

Identification Systems for Piping Should Be Uniform

PROPOSED tentative standards of a systematic plan for the identification of piping systems has been issued by the American Engineering Standards Committee. This committee, fostered by the National Safety Council and the American Society of Mechanical Engineers, was organized in 1922 and consists of 33 members representing 28 technical and industrial organizations.

Color schemes for the identification of piping systems have been developed in the past but they suffered from a complete lack of uniformity. In particular, there were no universal differentiations or designations between pipes and materials safe to handle and those unsafe. The principal requirements for a standard scheme of identification of piping systems are: distinguishability, flexibility, inclusiveness, simplicity, practicability, nationality. The proposed standard scheme meets as many of these requirements as possible and, while establishing a universal standard, leaves the maximum freedom of action for each plant and industry.

Five general classifications, A, B, C, D and E, representing safe products, dangerous materials, defective materials, extra valuable materials and fire protection equipment, respectively, have been made and the scheme proposes the use of identification symbols made up of three distinct marks, a band of color which indicates to which of the main classifications the material belongs, a stenciled legend abbreviated or otherwise placed on the color band, and where desired, additional colored bands of a contrasting hue. These identification marks shall be placed at intervals throughout the piping system to insure ready identification during repair operations and in an emergency.

As an alternative to the use of an identifying band of color, the entire piping system may be painted in the appropriate main classification color. In this case the legend or the stripe shall be placed at convenient intervals throughout the piping system, preferably adjacent to valves and fittings. Colors chosen to identify the main classifications are readily distinguishable from one another and are: Class A, green or the achromatic colors, white, black, gray or aluminum; Class B, yellow and orange; Class C, blue; Class D, purple, and Class E, red. Red has been assigned to Class E, fire protection equipment, because of long established custom.

The scheme as outlined is in tentative form only, made up for discussion and criticism, and it is hoped that the importance of the subject to all industries will result in widespread discussion which will help prepare the code and make it suitable for universal adoption.

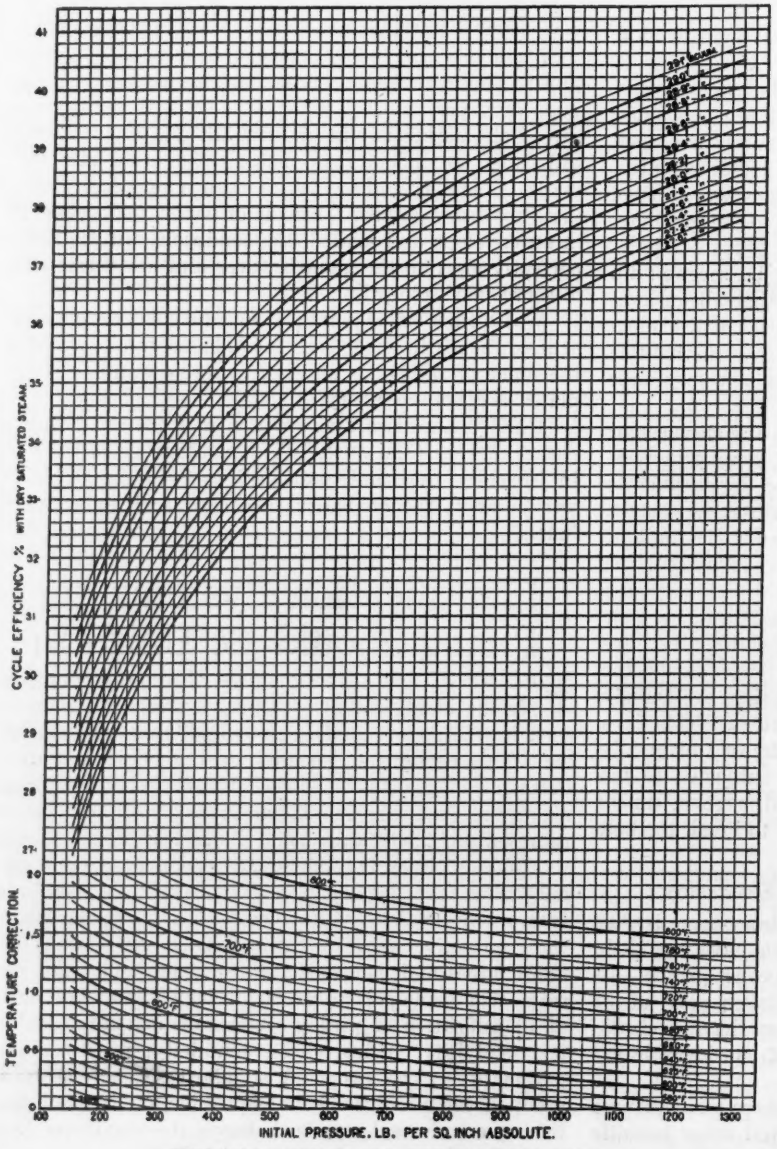
Quick Estimate of Rankine Cycle Efficiency

POSSIBLE heat efficiency of any steam-driven prime mover is found from the Rankine cycle, hence an easy method of determining the efficiency of that cycle for a given set of conditions is of great convenience, since it is with that possible efficiency that actual thermal performance must be compared to determine the effectiveness of use of heat.

J. P. Chittenden of the English Electric Co., Rugby, England, has prepared a chart for such determination, which appeared in Engineering of London and is here reproduced for convenience of American readers.

From the main curves is obtained the theoretical thermal efficiency for given pressure and vacuum for saturated steam. Correction for superheat is found from the lower set of curves.

As an example, for a plant at 600 lb. initial pressure, 29 in. vacuum and 750 deg. initial temperature: at 600 lb. and 29 in. the efficiency, from the upper curves, is 37.12. For 600 lb. and 750 deg., the correction, from the lower curves, is 1.5. Adding this to the first value, 37.12 + 1.5 = 38.62 as the possible thermal efficiency for the conditions stated. While there are very small errors in the correction curves, they are more accurate than data obtained from tests on actual plants.



EFFICIENCY CHART FOR THE RANKINE CYCLE

A COURSE in the prevention of accidents became a permanent part of the curriculum of New York University when that institution started its classes on Oct. 3, according to a statement by Arthur Williams, president of the American Museum of Safety, which is cooperating with the university in presenting the course, given last year as an experiment and meeting with unbounded success.

TOO MUCH of the world is run on the theory that you do not need road manners if you are a 5-ton truck.

Morrell Street Station Serves Detroit's Municipal Systems

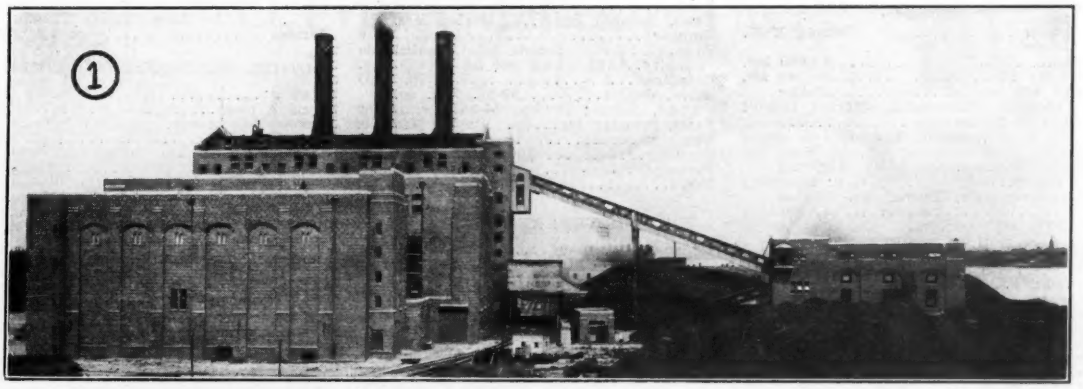
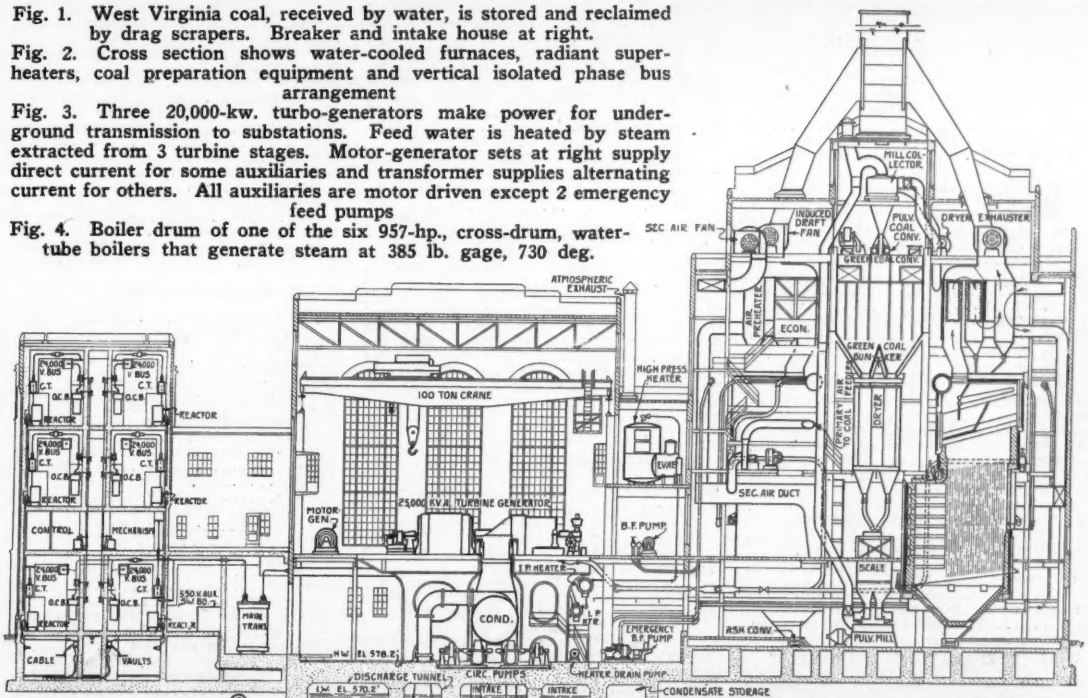


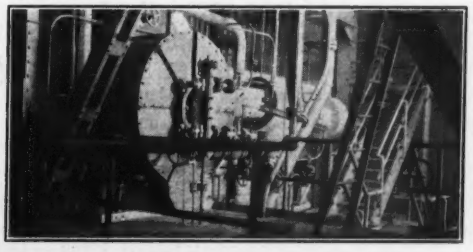
Fig. 1. West Virginia coal, received by water, is stored and reclaimed by drag scrapers. Breaker and intake house at right.

Fig. 2. Cross section shows water-cooled furnaces, radiant superheaters, coal preparation equipment and vertical isolated phase bus arrangement

Fig. 3. Three 20,000-kw. turbo-generators make power for underground transmission to substations. Feed water is heated by steam extracted from 3 turbine stages. Motor-generator sets at right supply direct current for some auxiliaries and transformer supplies alternating current for others. All auxiliaries are motor driven except 2 emergency feed pumps

Fig. 4. Boiler drum of one of the six 957-hp., cross-drum, water-tube boilers that generate steam at 385 lb. gage, 730 deg.





Principal Equipment in Morrell Street Station

GENERAL

LOCATION ..... Detroit, Mich.
CAPACITY
Present ..... 60,000 kw.
Ultimate ..... 80,000 kw.
BUILT FOR ..... Public Lighting Commission, City of Detroit
DESIGNING ENGINEERS ..... Smith, Hinchman & Grylls
GENERAL CONTRACTOR .... W. E. Wood Co.
SUPERINTENDENT, Public Lighting Comm. ..... F. R. Mistersky
SUPERINTENDENT, Morrell St. Station ..... L. J. Schrenk

BOILER EQUIPMENT

BOILERS ..... Babcock & Wilcox Co.
Number 6
Type ..... Sectional cross drum
Heating surface, sq. ft. 9571
Superheating surface, total sq. ft. 3640
Steam pressure, lb. abs. 400
Steam temperature ..... 730 deg.
Maximum stm. capacity. 200,000 lb. per hr.
SUPERHEATERS ..... Foster Wheeler Corp.
Type .... Combined convection and radiant
Surface, sq. ft. convection 3420
Surface exposed, sq. ft. radiant 219
FURNACES ..... Combustion Engrg. Corp.
Type ..... Lopulco; part fin tube water cooled: ventilated front and part of side walls; part radiant superheater
Number 6
Total cooling surface, rad. sup. and water walls ..... 1678 sq. ft.
Surface, two side walls ..... 842 sq. ft.
Surface, rear wall ..... 134 sq. ft.
Surface, water screen ..... 483 sq. ft.
Surface, rad. sup ..... 219 sq. ft.
Arches and front wall ... M. H. Detrick Co.
Firebrick ..... Acme and Hall Bros.
ECONOMIZERS ..... B. F. Sturtevant Co.
Number ..... 6, lead coated
Type 2-deck, 2-pass
Surface, sq. ft. 5016
AIR PREHEATER .... Combustion Engrg. Co.
Number ..... 6, plate type
Surface, sq. ft. each 10,980

COAL AND ASH HANDLING

DRAG SCRAPER ..... R. H. Beaumont Co.
Number 2
Capacity, 100 ft. radius .... 200 t. per hr.
COAL BREAKER .. Pennsylvania Crusher Co.
Capacity ..... 200 t. per hr.
MAGNETIC SEPARATORS .. Magnetic Mfg. Co.
TRACK SCALE ..... Fairbanks, Morse & Co.
BOILER COAL SCALES .. Richardson Scale Co.
APRON CONVEYORS, Belt Conveyors, Breaker House, etc. ..... Link-Belt Co.
COAL BUNKERS and Structural Steel, .. W. E. Wood Co.
ASH HOPPERS and Gates ..... R. H. Beaumont Co.
DRAG CONVEYOR, for ash removal ..... Combustion Engrg. Corp.

COAL PREPARATION EQUIPMENT

All supplied by Combustion Engineering Corp., as follows:
DRYERS ..... 4 Lopulco, steam heat
DRYER EXHAUSTERS 4
Drive .. 15-hp., 900-r.p.m., 550-v., a.c. motor
PULVERIZING MILLS .. 4 Raymond supermills
Capacity ..... 15 t. per hr.
Drive ..... 100-hp., 1200-r.p.m., a.c. motor
MILL EXHAUSTERS ..... 4 Raymond
Drive ..... 100-hp., 1200 r.p.m. a.c. motor
MILL AUTOMATIC FEEDER ..... 4, Raymond
Drive ... 1-hp., 900-r.p.m., 550-v. a.c. motor
PULVERIZED COAL COLLECTORS 4
PULVERIZED COAL CONVEYORS .. 2 sets, screw
Capacity ..... 32.5 t. per hr.
PULVERIZED COAL FEEDERS .... Total No. 60
Type ..... Duplex, 10 per boiler
Drive ..... 2.5-hp., var. sp. d.c. motor
PULVERIZED COAL BURNERS ..... Forced draft type
Number ..... 10 per boiler

FANS AND DRAFT EQUIPMENT

STACKS, STEEL ..... W. E. Wood Co.
Number ..... 3, lined
Diameter ..... 12 ft.
Height above roof ..... 70 ft.
Support ..... Building steel
BREECHINGS, DUCTS AND FLUES ..... W. E. Wood Co.
FANS, Secondary Air ..... Bayley Mfg. Co.
Number 6
Type ..... Double inlet, multiblade
Capacity ..... 54,000 c.f.m. at 70 deg.
Head ..... 3 in. H_2O
Drive ..... 50-hp., var. sp., d.c. motor
FANS, Induced Draft ..... Bayley Mfg. Co.
Number 6
Type ..... Double inlet, multiblade
Capacity ... 260,000 lb. per hr. at 635 deg.
Pressure ..... 5.25 in. H_2O
Drive, duplex ..... 50-hp., var. sp. d.c. motor; 200-hp., 550-v. a.c. motor
FANS, Primary Air ..... Bayley Mfg. Co.
Number 6
Capacity ..... 8500 c.f.m. at 250 deg.
Pressure ..... 20 in. H_2O
Drive ..... 50-hp., var.-sp. d.c. motor

PRIME MOVERS AND AUXILIARIES

TURBO-GENERATORS ..... Westinghouse Elec. & Mfg. Co.
Number 3
Capacity ..... 20,000 kw., 0.8 p.f.
Steam pressure, throttle ..... 385 lb. gage
Steam temperature, throttle ..... 730 deg.
Steam pressure, exhaust ... 1 in. Hg. abs.
Speed ..... 1800 r.p.m.
TURBO-GENERATOR, Emergency ..... General Electric Co.
Number ..... 1, non-condensing
Capacity ..... 1000 kw., 0.8 p.f.
Steam at throttle ..... 385 lb., 730 deg.
Speed ..... 3600 r.p.m.
CONDENSERS, Main. C. H. Wheeler Mfg. Co.
Number ..... 1 per turbine
Type ..... Horizontal, surface, 2-pass
Surface, sq. ft. 27,000
Number of tubes 5160
Tubes ..... 1 in. o. d. admir. metal, 18 B. W. G., 20 ft. 3 in. long
CONDENSER CIRCULATING PUMP ..... C. H. Wheeler Mfg. Co.
Number ..... 2 per unit
Type ..... 1-stage, centrifugal
Capacity, each .... 18,000 g.p.m. 20 ft. head
Drive ..... 125-hp., var.-sp. d.c. motor
CONDENSATE PUMP C. H. Wheeler Mfg. Co.
Number ..... 2 per unit
Type ..... 3-stage, centrifugal
Capacity ..... 600 g.p.m. 192 ft. head
Drive ..... 100-hp., 1750-r.p.m. a.c. motor
AIR PUMP ..... C. H. Wheeler Mfg. Co.
Number ..... 2 per unit, Radojet
Capacity ..... 20.6 c.f.m. at 1.5 in. abs.
TRAVELING WATER SCREENS Chain Belt Co.
Number 4
Size ..... 10 ft. 8 in. wide
Drive ..... 5-hp. motor

EVAPORATOR AND HEATERS

EVAPORATOR ..... The Griscom-Russell Co.
Number ..... 3, Reilly, hor. st. shell
Capacity ..... 5500 lb. per hr. at 203 deg. into vapor at 14.7 lb. abs., steam at 62 lb. 95 deg. superheat
EVAPORATOR FEED HEATER ..... The Griscom-Russell Co.
Number ..... 3, Reilly vertical
Capacity ..... 5500 lb. per hr. from 55 deg. to 203 deg. with steam at 14.7 lb. abs., 98 per cent dry
EXTRACTION HEATERS .. Alberger Heater Co.
Number ..... 3 low press, 3 int. press
Surface ..... Low press, 960 sq. ft.; int. press, 1100 sq. ft.
EXTRACTION HEATER ..... Cochrane Corp.
Number 3
Type .... H. P. open, receiver, deaerating
Capacity ..... 263,000 lb. H_2O per hr. from 217 deg. to 312; steam at 82 lb. abs. Storage, 500 cu. ft.

PUMPS

BOILER FEED PUMPS ..... De Laval Steam Turbine Co.
Number .3 motor driven .2 turbine driven
10 stage ..... 5 stage
Type ... 2 units in series
Capacity 625 g.p.m. ..... 1000 g.p.m.
Head .. 550 lb. ..... 550 lb.
Sneed .. 1200 r.p.m. .... 2000 r.p.m.
Drive .. 300 hp., d.c. mot. Steam turbine
SUMP PUMPS ..... Yeomans Bros. Co.
Number ..... 1 Shone Air Ejector
Capacity, each ..... 100 g.p.m.
SERVICE PUMPS. De Laval Steam Turb. Co.
Number ..... High press., 3; low press., 4
Capacity, each ..... 1000 g.p.m.
HEATER CONDENSATE PUMPS ..... De Laval Steam Turbine Co.
Number 6
Capacity ..... 100 g.p.m.
MAKEUP PUMPS. De Laval Steam Turb. Co.
Number 2
Capacity ..... 600 g.p.m.
TEST PUMPS .. De Laval Steam Turb. Co.
Number ... 2 (1 150 g.p.m.; 1 750 g.p.m.)
SCREEN CLEANING PUMP ..... De Laval Steam Turbine Co.
Number ..... One, 200 g.p.m.

OTHER MECHANICAL EQUIPMENT

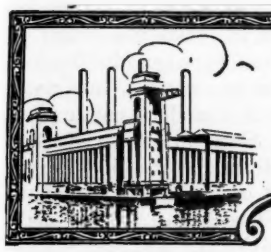
CRANES ..... Whiting Corp.
Turbine room ..... 100 t.
Screen Well House ..... 8 t., hand op.
Coal unloading ..... 5 t.
LOCOMOTIVE CRANE .... Plymouth, gasoline
FEED WATER REGULATORS ..... (Copes) Northern Equipment Co.
SOOT BLOWERS .. Diamond Power Spec. Co.
SOOT CONVEYORS .... Girtanner Engrg. Co.
WATER COLUMNS .... Babcock & Wilcox Co.
VALVES
Blowoff, H. P. globe, H. P. gate, H. P. check ..... Lunkenheimer Co.
Safety ..... Consolidated (Manning, Maxwell & Moore, Inc.)
Small H. P. valves ..... Hancock (M. M. & M., Inc.)
Atmospheric relief .. G. M. Davis Reg. Co.
Reducing valves ..... Crane Co.
WATER TANKS ..... R. C. Mahon
MOTOR OPERATORS FOR VALVES ..... (Dean) The Cutler-Hammer Mfg. Co.
PIPING ..... Johnson Larsen Co.
PIPE AND DUCT INSULATION ..... Philip Carey Co.
STEAM TRAPS ..... Crane Co.
HEATING SYSTEM ..... Johnson Larsen Co.
OIL PURIFIERS .... De Laval Separator Co.
Number ..... 4 (225 g.p.h. each)
OIL COOLERS ..... The Griscom-Russell Co.
Type ..... Multi-whiri
Number ..... 3 (Size 116)
AIR COMPRESSORS .... Bury Compressor Co.
Number 2
Capacity .... 600 c.f.m. at 70 deg., 110 lb.
Drive ... 125-hp., 550-v. synchronous motor
FLOORING AND STAIRS ..... Subway grating in boiler house; tile floor in turb. room and main boiler room

ELECTRICAL EQUIPMENT

MAIN GENERATORS ..... Westinghouse Elec. & Mfg. Co.
Number 3
Capacity ..... 20,000 kw., 0.8 p.f.
Speed 1800
Voltage 13,200, 3-phase, 60-cycle
Exciter ..... 250-v., direct connected
EMERGENCY GENERATOR ..... Gen. Elec. Co.
Number 1
Capacity ..... 1000 kw.
Speed ..... 3600 r.p.m.
Voltage ..... 550 v., 3 phase, 60 cycle
Exciter ..... 250-v., direct connected
MOTOR GEN. SETS .... General Electric Co.
Service ..... 250-v., d.c., house supply
Capacity ..... Four, 500 kw. each
STORAGE BATTERIES ..... Electric Storage Battery Co.
Number ..... 1 set, 60-cell
Capacity ..... 900 amp-hr.
M-G SETS for Storage Battery Charging .... 2 Westinghouse E. & M. Co.
GENERATOR AIR COOLERS ..... The Griscom-Russell Co.
MAIN TRANSFORMERS .. General Electric Co.
Number 3
Type ..... Auto transformer
Capacity ..... 25,000 kv.a. each
Voltage 13,200-24,000
HOUSE TRANSFORMER .. General Electric Co.
Number 4
Type ..... Two winding
Capacity ..... 1500 kw.
Voltage ..... 24,000-550-v.
OIL CIRCUIT BREAKERS ..... Westinghouse E. & M. Co.
Capacity ..... 600 and 1200 amp., 24,000 v.
DISCONNECTING SWITCHES ..... Westinghouse E. & M. Co.
LIGHTNING ARRESTERS ..... Westinghouse E. & M. Co.
BUS CELLS ..... Deceleco cell structure
INTERLOCKS, Mechanical and Electrical ..... Chas. Cory & Son, Inc.
AUXILIARY MOTORS .... General Electric Co.

METERS AND INSTRUMENTS

SWITCHBOARDS and Electrical Meters ..... Westinghouse E. & M. Co.
BOILER CONTROL BOARDS ..... Leeds & Northrup Co.
Flow meters ... (G. E.) Bailey Meter Co.
Draft gages ..... Bailey Meter Co.
Boiler F. W. meters .. Builders Iron Fdry.
Temp. recorders .... Leeds & Northrup Co.
CO_2 recorders .... Bacharach Ind. Inst. Co.
Pressure gages ..... The Foxboro Co., Inc., Ashcroft Mfg. Co.
Master gages ..... Chas. Cory & Sons, Inc.



LETTERS DIRECT FROM THE PLANT

Chain Rigging Around Power Plants

In the erection of power plant machinery and also in its maintenance, we still often see chain slings used for attaching parts to be lifted to the crane hooks. I hope that every reader who is in a position to do so and is concerned with such work will use his influence to have such chain slings and similar parts scrapped for there have been a great many accidents due to the use of chain for such purposes. The chains, if kept for any long period, will become crystallized and eventually drop a load when least desirable.

Annealing is a great help if done regularly and carefully, but even then the internal condition of the metal is a matter of conjecture. The solution to this problem is to use many-stranded steel cable of the flexible type, which when stressed to its breaking point usually fails by strands and not all at once; in most cases enabling the load to be lowered or the workmen to get out of the way at least. Not long ago a casting weighing about 95,000 lb. dropped on account of a defective chain sling that let go at one link weld. This chain had been regularly annealed and the chain itself was good for many times the actual load.

An exceedingly handy form in which to have cable slings made up is to have an eye at each end, one eye being large enough to pass the other eye through it, and the large eye being of the right size for the crane hook. Where possible, the use of hooks on the slings themselves, or any other type of connection piece that has one side open such as a hook, is to be discouraged on account of the tendency to slip under load and let the load drop.

The use of hemp or manila ropes for lifting important parts around a power plant is to be condemned, although people get away with it until something happens.

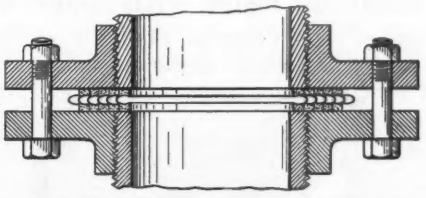
York, Pa. John S. Carpenter.

High Pressure Oil Connections Made Tight

Referring to the letter by Chas. Labbe, published on page 1004 of the September 15 issue, it is unnecessary to scrape ordinary pipe flanges carefully in order to make a leakless fit.

There is a gasket on the market which is a combination steel and asbestos gasket, wound round and round from the inside outward with layers of asbestos between the steel, as shown in the accompanying sketch. With this gasket no shellac or treatment of any kind is required. Treatment may be used if desired but it is not necessary. Nor should the gasket be bolted up tight. It is a "flexible metallic gasket." The flexibility and strength of the steel causes the edges of the steel strip to press against the flanges at such a high pressure per square inch of steel that there can be no leakage even when the total pressure of all of the bolts is comparatively small.

Flat gaskets made of paper, such as described by Mr. Labbe, are notoriously poor and should never be used. This type of flexible metallic gasket takes care of irregularities in the flanges to a considerable extent. But, of course, unless the faces of the flanges are parallel, unequal strains will be set up owing to the expansion of the pipe, and failure will result. Gaskets that compress during service and which do not have sufficient elasticity to recoil, always require following up of the bolting and should be avoided.



U-SHAPED METALLIC RINGS WOUND ON TOP OF ONE ANOTHER, SURROUNDED WITH SHEET ASBESTOS MAKES TIGHT FLEXIBLE PACKING

The gasket illustrated is successfully used with pressures as high as 1000 lb. per sq. in. The writer knows of an instance where one of these gaskets was placed on a vessel having no opening other than the opening that was closed by the gasket itself. By means of a hydraulic pump, water was pumped into the vessel to a pressure of 1000 lb. per sq. in. There was no air in the vessel whatever. The gasket held the pressure at 1000 lb. for many hours without any change in pressure other than that due to the change in temperature. As the temperature increased the water naturally expanded and pressure increased. As the temperature decreased the pressure decreased. In other words, the vessel was sealed perfectly tight by the gasket.

With these gaskets it is important that the faces be maintained nearly parallel to each other during service so that there will be a fairly uniform distribution of pressure all over the gasket. While it is true that they are very good, they are not foolproof. They cannot do the impossible.

Newark, N. J. W. F. Schaphorst.

Try This!

Perhaps some of the readers using testing kits for finding the softness of treated water have experienced difficulty in removing the air bubble that is sure to be

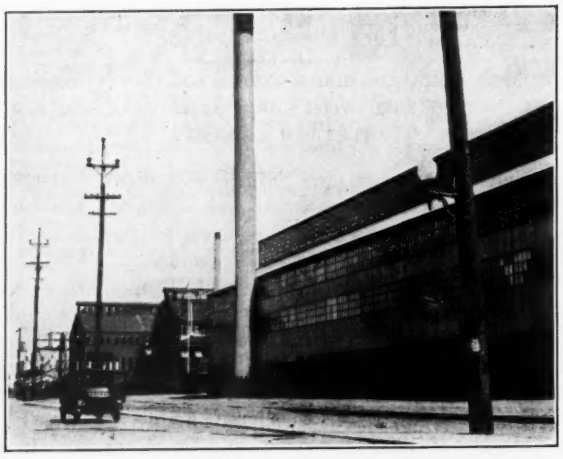
entrapped in the tip of the burette when it is filled with chemical. The type of burette we are using consists of a graduated glass tube, filled at the top and stoppered at the bottom with a short length of rubber hose provided with a clamp. The above-said aggravating and persistent air bubble lodges in this hose, and it is only with a milking motion applied to the hose that the air can be worked out. This is tedious and uncertain. If the bubble remains, it is liable to introduce an error in the burette readings should any part of it work out during the test.

Our remedy is, with the burette entirely empty, to lower the hose tip into the chemical, put the open end into your mouth and suck the chemical above the hose connection into the tube; the chemical can then be poured in from the top without entrapping any air. Though crude and primitive, we believe this method effective. Try it!

Gainesville, Fla. G. Corwin Robertson.

Unique Effect of Painting Stacks with Aluminum Paint with Black Top

Stacks of the Columbia Steel Co. at Pittsburg, Calif., present a unique appearance since they were painted with aluminum paint with the exception of a



BLACK STRIPE AT TOP OF STACK PRODUCES STRIKING EFFECT

section at the top which is painted black. Each stack is equipped with a steel ladder which greatly facilitates the work of painting and gives easy access to all sections of the stack.

San Francisco, Calif. C. W. Geiger.

Triple Duty Stop Valves and Dry Pipes

On page 1110 of the October 15 issue, Mr. Cultra criticises that part of my article on dry pipes that deals with the use of the triple duty stop valve. It is some time since I had anything to do with one of them, and to be sure that there is still "such an animal" I have looked through the advertisements of a recent copy of this journal, and sure enough I find there one which is guaranteed to "automatically cut off the steam flow from every boiler the instant that a steam pipe bursts."

Closing of these valves is controlled by a dash pot and the result is the same as if the valve was closed by hand. It is also much the same as when the demand for steam suddenly ceases from any cause. It is not a rare occurrence for the boilers of a modern power plant to be producing steam three times in excess of their normal rating for use by the steam turbines one minute, and the next, due to the effect of a dead short and the total loss of load, using very little steam. All the steam except the small amount used by the auxiliaries, goes roaring out through the safety valves and no one expects disaster to the boilers. If the water in the boiler is in the condition that Mr. Cultra pictures it to be, I will admit that a certain amount of water can be expected to leave with the steam, but I had a modern power plant in mind when I wrote my article.

Safety valves allow all the steam that the boiler can produce to escape without appreciable rise in pressure. Further, a properly designed safety valve does not cause a sudden reduction of pressure in the boiler nor even an appreciable reduction in pressure because it closes immediately when the pressure falls a few pounds below that at which it opened. To my mind the dry pipe is not worth arguing about, but like the steam dome is doomed to extinction.

Water should not be able to collect at any point in the steam line save in a properly designed separator. To take care of slugs passing over from the boiler, the separator should be as near to the boiler as possible so that the slug will be quickly rendered harmless. The fewer changes of direction a slug has, the better, but why not do away with slugs? It is advisable to have a separator near the engine to take care of condensation, and to act as a reservoir, thereby preventing vibration in the steam line due to the intermittent flow of steam to the engine. Steam separators are useless if they are not kept drained by a good steam trap. They should be frequently inspected.

Long Beach, Calif. E. J. Jordan.

Care of Fire Tools

In one boiler room, the rake, slicer, clinker-bar were thrown indiscriminately upon the coal pile, just as the tools came from the furnace after cleaning a fire. The rake was bent and its three teeth twisted out of shape. The clinker-bar was so bent or "hogged down" that the tool looked more like a rainbow than a clinker-bar! The slice-bar was bent and the blade of the tool twisted to one side until the tool resembled a hatchet.

In the other boiler room each tool hung upon little bracket hooks and each tool was straight and seemingly in as perfect condition as the day it came from the smith-shop. Upon being asked how he kept the fire tools in such good condition, the fireman pointed to a six-foot length of 10-in. channel steel which lay upon a piece of timber along one of the boiler house walls. Beside the steel channel was an immense mallet or maul, made of hardwood and about 8 in. square and nearly 2 ft. long; a stout handle about 2 ft. long enabled the mallet to be used with one hand.

After using one of the tools in the fire, and while still hot, the tool would be pushed upon the steel beam

and a few well directed blows of the heavy wooden maul removed whatever kink or bend might have developed during its use in the fire. The teeth of the rake were kept in shape by straightening them against the flanges of the channel, a tap or two of the big mallet serving to knock back into position any one of the teeth which might have become bent while hauling a heavy clinker out of the furnace.

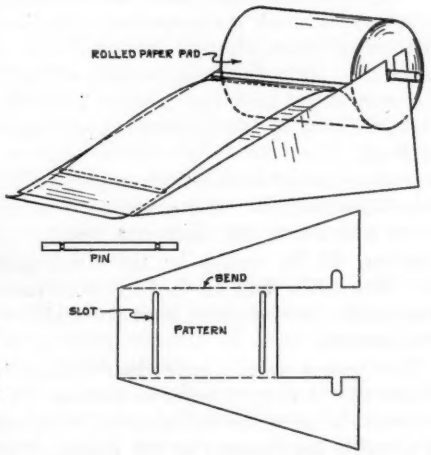
Hanging to the handle of each one of the fire tools was a small hook, such as is used by freight handlers and roustabouts for getting hold of boxes and other packages. When using one of the fire tools the fireman always took this hook in his left hand and used the hook for supporting and lifting the tool, instead of permitting the hot and dirty tool to slip through his hand.

Three brackets had been provided for receiving the fire tools, one bracket near either end of the tools, the other bracket midway between the two outer ones. On each bracket, lugs or hooks had been provided for four tools. These lugs were short pieces of Z bar which had been hack-sawed off and riveted to a vertical piece of light channel steel, the three pieces being bolted to the boiler room wall. Four hooks on each bracket had been provided so as to have room for an extra fire tool.

Indianapolis, Ind. JAMES F. HOBART.

Sheet Metal Holder for Rolled Memorandum Pads

SHEET METAL cut out and bent up as shown in accompanying illustration makes a simple shop-made holder for rolled memorandum paper. This holder,



HANDY ROLLER PAD CAN BE READILY MADE FOR USE IN POWER PLANT

which is of one-piece construction, can be made in a few minutes of spare time. The bottom front edge is sharpened slightly so that the slips may readily be torn off as required.

This holder should be made with slots only slightly longer than the width of the roll paper used and the roller pin should be provided with grooves so as to prevent it from falling out. A half dozen of these will find ready use in any plant.

Washington, D. C. G. A. LUERS.

Beautification of Water Works Grounds Pay

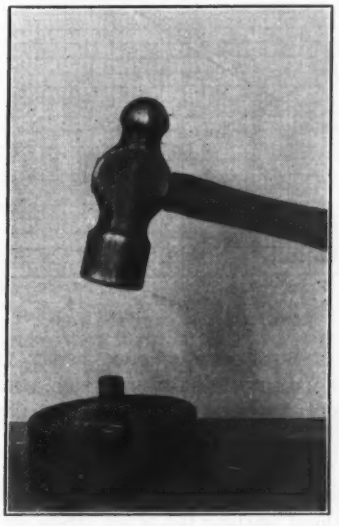
REFERRING to the article on Beautiful Surroundings Are an Asset to Industry, published on page 1039 of the October 1 issue, I wish water works people would appreciate the advantage and profit gained by paying attention to the appearance of the grounds as well as to the architectural features of the buildings.

This is not an item of expense but is an excellent investment. Thousands of visitors come to our plant. On Sundays and holidays we are obliged to have the assistance of uniformed police in order to regulate traffic. People here say the first thing they do when persons come from out of town is to show them the water works. This has a moral and educational effect upon the public as well as the employes.

Des Moines, Iowa. CHARLES S. DENMAN,
General Manager, Water Works.

Discarded Part Serves as Protection

WHEN STRIKING or tapping old rusty studs to loosen them before turning out, or driving out small bolts where the hammer might miss and damage joints or



OLD WATER PUMP VALVE HAS VERY PRACTICAL USE

other surfaces, an old discarded rubber valve from a water pump can be used to serve as a ready and practical guard.

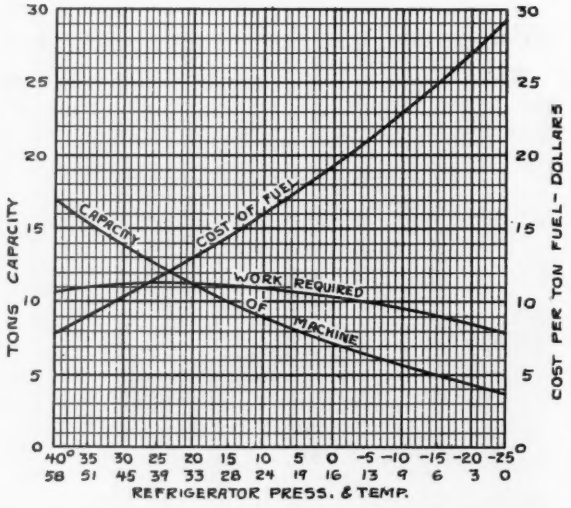
Missouri Valley, Iowa. FRANK W. BENTLEY, JR.

THE ERSTE BRUNNER MASCHINENFABRIK of Brunn, Austria, has recently constructed and installed at the collieries of the Witkowitz Co. in that country, a 26,000-hp. turbine designed to run at 3000 r.p.m. and to work with steam at a pressure of 100 atmospheres (1470 lb.) and at a temperature of 450 deg. C. (842 deg. F.). The necessary steam is supplied by a Löffler type boiler generating steam at from 100 to 120 atmospheres pressure and a number of boilers working at 15 atmospheres and fired by the waste gases from the coke ovens.

QUESTIONS AND ANSWERS

Ice Plant Operating Costs Affected by Various Factors

In some of your recent issues I have paid particular attention to a few articles on how an ice machine should be run. I have come to the conclusion that refrigeration plants are installed to keep products at a certain temperature or to turn out as many tons of ice as possible.


TONS CAPACITY
COST PER TON FUEL - DOLLARS
CAPACITY
COST OF FUEL
WORK REQUIRED OF MACHINE
REFRIGERATOR PRESS. & TEMP.
40° 35 30 25 20 15 10 5 0 -5 -10 -15 -20 -25
58 51 45 39 33 28 24 19 16 13 9 6 3 0

RELATION BETWEEN COST OF FUEL, WORK REQUIRED AND CAPACITY OF MACHINE FOR DIFFERENT CONDITIONS OF PRESSURE AND TEMPERATURE IN THE REFRIGERATOR OF AN ICE PLANT

Engineers should, I believe, be given credit for production without putting too much stress on the economy of manufacture. Refrigeration plants are installed with a limited amount of condensers and cooling coils. This being the case, the engineers must run their ice machines so that the best results may be obtained regardless of whether he has 5 lb. suction gage pressure or 30 lb. suction gage pressure. It is said by all authorities on refrigeration plants that the higher the suction gage pressure the more economical a plant can be run. There is nothing said about the rise in condenser gage pressure corresponding to rise in suction pressure also corresponding rise in cooling coil gas from expansion valve. I believe in some cases there is an increase in horsepower as well. H. R. L.

A. Your question may best be answered by reference to the accompanying diagram, which shows that the back pressure has considerable influence upon the cost of fuel required and upon the capacity of the machine. For example: at 30-lb. suction the relative capacity of machine and work done will be 10½ and 11¼ while for 5-lb. suction these values are only 4¾ and 8¾.

Boiler and Pump Questions

Please let me have the following information through your columns:

1. How can the safe working pressures, complying with the Massachusetts Boiler Rules, be found for locomotive and Manning type boilers?

2. Why are the suction valves in a fire pump, as used in the mills, placed below the plunger while in a boiler feed pump they are above the plunger? A. L. P.

A. The safe working pressure is that which is safe for the weakest element in the boiler conforming with the Massachusetts rules. There are about 200 items in all that must be checked, many of which do not require calculation, but must nevertheless be regarded if the boiler is to be operated in Massachusetts.

The main elements which must be checked mathematically in a locomotive type boiler are: strength of longitudinal seam, strength of girth seam, strength of stay bolts, thickness of fire sheets, area of segments of head and strength of bracing used. In a Manning boiler it is necessary to check mathematically the strength of the longitudinal seam, strength of stays and thickness of fire sheets. Methods of calculating all of the preceding strengths are given in "Steam Boiler Rules," a pamphlet published by the Department of Public Safety, Boston, Mass.

Many other features limit or even prevent the use of boilers in Massachusetts. For example, if a boiler were fitted with a cast-iron fire door ring instead of one of steel casting, 15 lb. would be the limiting pressure allowed. If a boiler had an O. G. bottom instead of a base ring or if it used flanged steel it could not be used in Massachusetts.

2. Fire pumps usually have their suction valves located below the plunger in order to increase the areas of these valves so as to reduce the friction through them and thus to increase the capacity of the pump. This can be done in the case of fire pumps because they are intended to be operated under a positive suction head. When fire pumps are operated at all it is desirable that they run at the highest possible capacity. Such operation may be accomplished with such pumps because, unlike boiler feed pumps, they are operated only occasionally and then for comparatively short periods of time.

Effect of Heating Cylinder Oil

We have a 550-gal. tank located in a reasonably warm place, about 6 ft. above our engine cylinder. In this tank we keep a purely mineral cylinder oil. In extremely cold weather this oil becomes so heavy that

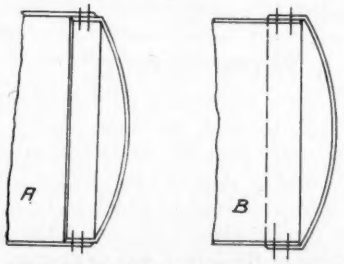
it will not flow freely. Would it be injurious to the oil to place a steam coil in the tank to heat the oil or would it not be better to have the cylinder oil filtered so as to remove the heavier products and make the oil translucent instead of opaque. J. A. G.

A. It would do no harm at all to heat the oil to a temperature that would cause it to flow in a normal manner. It should not be heated above its flash point.

It would be better to heat the oil than to remove any of its products as, in the latter case, there would be a loss in lubricating value since the heavier products have some lubricating value and add to its viscosity under operating conditions. If the viscosity is much reduced, the oil may become too light for the use demanded of it.

Bumped Heads for Pressure Drums

SKETCHES HEREWITH show two different methods of attaching bumped heads to pressure drums. So far as I know all pressure vessels up to the present time were built according to A. Lately I noticed a pressure drum 6 ft. diameter, working under a pressure of 350 lb. at 850 deg. F., which had heads placed on the outside as



METHOD OF ATTACHING HEAD MAKES LITTLE DIFFERENCE IN STRENGTH OR TIGHTNESS OF JOINT

shown at B. What are the relative advantages of these two methods of attaching heads? A. C.

A. So far as strength of joint is concerned, there is little difference in the two forms shown. At first glance it may be expected that the expansion of the shell, when under high pressure, would tend to loosen the joint between the head and shell in the A form, but under usual practice the rivets are amply strong to cause the joint to retain its tightness.

Under certain conditions of operating as in the packing industry where acid gases are formed, it has been found that greater security of joint has been found in the B form of attachment.

There is no material difference in the strength of the head as a dished plate, although from this point of view the form A would have a very slight advantage over form B. Choice is largely based upon appearance.

Rapid Heat Changes Leakages

IN OUR PLANT we have three hand fired h.r.t. boilers 72 in. diameter and 16 ft. long, having 70 4-in. flues. These boilers carry 125 lb. steam pressure and burn 7 t. of coal in 24 hr. in Chicago furnaces. Two of these boilers are usually in service while one is kept in reserve for cleaning and repair.

Tube leakage frequently occurs; 50 to 60 tubes have to be re-expanded every three months in order to stand a cold water test of 115 lb. Two of the boilers are 15 yr. old and have scale ⅛ in. thick. We retubed these boilers a year ago. Soft iron had been used by the makers for ferrules; should not copper have been used for this purpose? Some engineers say that the tube holes are not round and that they should be ground round.

Steam is supplied to an engine which carries, at times, a load of 300 hp. for periods of about 2 hr. The normal load on the engine is from 160 to 190 hp. Besides this, steam is furnished to a steam press 44½ in. diameter and 42 in. stroke. This is used to press out 15-in. sewer pipe at a rate of about 200 per hr. When the press is in use it is necessary to fire the boiler hard and when it is suddenly stopped, the firing must be light. It may be that the press will be put into service again in 5 min., which may draw the steam pressure down to 10 or 15 lb. and hard firing is required to get the pressure back to 125 lb. Could the leakages be caused by firing too hard or could they be due to pulsations set up in the feed water which enters the boilers at about 200 deg.? C. M. S.

A. It is difficult to state definitely just what you should do to overcome your difficulty without making a personal examination of your equipment, but there is no question, however, that if the tube holes are not round there will be difficulty in expanding the tubes so as to prevent leaks. Soft iron should work all right for ferrules under normal conditions.

Violent changes in temperature due to rapid variation in load causes expansion and contraction of the tubes which eventually may result in leaks. Larger steam capacity would aid you. With your present equipment the two boilers in service do not furnish enough steam to supply your engine when operating at 300 hp. especially when, as may be the case, the steam press is suddenly put into service. You may help your condition to some extent if you establish a signal alarm by which you will be notified ahead of time when the steam press is to be put into service, but additional steam capacity, we believe, would be the best solution.

Editor's note: We shall be glad to receive suggestions from those who have experiences similar to that of the above reader regarding the solution of his trouble.

Lifting Power of an Air Hoist

IF THE CYLINDER of an air hoist is 39 sq. in. and the pressure in the air line is 84 lb. to the sq. in., how many pounds will the air hoist lift? F. A. R.

A. Since there will be a pressure of 84 lb. on each square inch of the piston in this cylinder, then the total pressure on the piston will be $84 \times 39 = 3276$ lb. If this force is exerted directly on the load, making due allowance for friction of the parts and various losses, in other words, the mechanical efficiency of the machine, it would probably lift about 3000 lb. The distance which it would lift this amount would be determined, of course, by the speed and the distance and this, of course, would depend on the way in which the force was transmitted from the piston of the hoist to the load to be lifted.

Power Required to Lift Materials

WHAT HORSEPOWER would be required to raise 2500 lb. of coal 150 ft. in 1 minute if the efficiency of the apparatus is 50 per cent? L. J. W.

A. $$\frac{2500 \times 150}{3300 \times 0.50} = 22.7 \text{ horsepower}$$

EDITORIAL COMMENT

Horsepower and Federal Power

When a government commission states that it would be glad to have less power it is worthy of more than passing note. When the Secretary of the Federal Power Commission agrees with the Managing Director of the National Electric Light Association that, for protection of public interests, state regulation, where it exists, is better than Federal regulation, it would seem that agreement should easily be reached as to a desirable policy, if politicians will keep hands off.

There is practically no disagreement as to public interest and rights in protection of navigation facilities and development of water powers. But whether the emphasis shall be placed on protection of public interests or on ballyhoo to catch votes depends on the viewpoint of the individual who does the talking.

In the Appalachian region, the Carolinas, Georgia, Alabama and Tennessee, waterpower is important, hence it was a logical subject for discussion at the recent Southern Appalachian Power Conference at Chattanooga. And it is notable that executives of public utility organizations and officials of government agencies were largely in agreement as to objects to be sought in water power development. Secretary Merrill of the Federal Power Commission, Major Edgerton of the U. S. Engineers and Director Clapp of the N. E. L. A. were a unit that all were working for "complete utilization of our water resources.

While navigation facilities should not be interfered with by power projects, power possibilities should not be lessened by developments to improve navigation. Fortunately, as was pointed out, requirements for navigation and power are usually in agreement or can easily be reconciled if development of a stream is considered as a whole and not attempted piecemeal for temporary immediate advantage. It is on this basis that Federal agencies can be and are of use for few states have given consideration to the question of economic or wasteful development of power resources. In the matter of capitalization, service and rates, however, state regulation has been satisfactory, in most instances and Secretary Merrill stated that, only in cases where state regulation was lacking, had the Commission assumed responsibilities which it preferred to avoid as they should better be taken by the states. He said that the Commission would welcome state assumption of greater responsibility than is now taken for rate, service and security regulation, inspection of construction to insure safety and adequate maintenance and auditing of accounts to avoid excessive construction costs on which rates are based.

This would leave to Federal agencies only the safeguarding of navigation and of rights where several states are interested in a stream or it is an international boundary subject to treaty regulations.

As to interconnected systems, while these bring great advantages in the possibility of economy of loading, emergency supply and utilization of seasonal water power, not over 7 per cent of all electrical energy generated ever crosses state lines, so that federal regulation as a matter of interstate commerce is fallacious.

It would seem that the fields for proper activity of the state commissions and the Federal Commission are rather clearly defined, that commissions and those engaged in the industry are in close agreement as to those fields and that, if politicians and publicity-seeking reformers can be kept out of the picture, intelligent solution of all problems and satisfactory development of water resources can be accomplished as rapidly as economic conditions warrant.

What Is a Water Screen?

What is a water screen in a pulverized coal furnace? We have always thought we knew exactly what it is. We have considered that the water screen is the single bank of horizontal or sloping tubes at the bottom of the furnace, connected to headers which in turn are usually connected to the circulation system of the boiler. The original purpose of the screen was to prevent slagging of ash at the furnace bottom; it has now been found that it adds to the heat-absorbing capacity of most boilers.

In the early stages of pulverized coal development, when air-cooled furnaces were common, with a water screen at the bottom to prevent slagging, the term water screen could mean only one thing.

Now, however, with the introduction of various types of water-cooled furnace walls, in both stokered and pulverized coal furnaces, there seems to be a growing confusion, especially among operating engineers, as to the proper terms for the various water-cooled surfaces.

We have heard the side walls called "water screens," "side wall screens," and so on. We have even heard the term incorrectly applied to water backs in stoker-fired furnaces.

Introduction of the radiant type superheater into the furnace wall has given rise to further confusion. If we have a water-cooled furnace wall, including radiant superheater elements, how shall we classify the latter? It is true that, from the furnace standpoint alone, the radiant superheater takes heat away just as do the water-cooled walls. From the standpoint of the boiler, however, water-cooled walls are water-heating surfaces, while the radiant superheater is a steam-heating surface.

It would seem that in respect to the radiant superheater terms we can do little. Whenever we are referring to a water-cooled furnace wall, which also contains a radiant superheater, we shall have to specify carefully just which one we mean, both from the standpoint of furnace cooling and of heat transfer to water and steam.

Regarding the water screen at the bottom of the fur-

nace, however, it has been suggested by one of the subcommittees of the N. E. L. A. prime movers committee that this be called the hearth screen. Such a clarification of the term would be especially helpful in writing specifications. We feel that this is an excellent suggestion, even better than the suggestion to call it a slag screen. The word hearth more nearly denotes its function; besides, the word hearth, so far as we know, is not applied nowadays to any other part of a power boiler. Clearness of the term hearth screen certainly recommends it.

In regard to other parts of the heat absorbing surface of the furnace, it is probable that the terms now used will stand as they are. For use in writing specifications, however, the various terms should be clearly differentiated. The industry should welcome any suggestions that will assist in doing this.

Contribute Your Experience to Keep the Pot Boiling

Things you regard most highly are generally those you do not have. Characteristics you most admire are generally not your own. Those problems that seem hardest are those you do not understand.

What you are doing daily in your plant may seem to be commonplace to you but your brother engineer may not know about it. Throw it into the pot, let it be boiled down, seasoned a little, a little spice possibly added, and after it has been cooked up a bit it may be garnished with attractive caption and perhaps catchy subheads and then served up in such a form that it will be relished by many readers.

We shall be glad to do the cooking—just let us have your experience. Remember we do no roasting.

Off Duty

We were quite intrigued recently by a report issued by the U. S. Chamber of Commerce on "Our World Trade" which happened into our hands on one of our Off Duty moments. Ordinarily statistical material does not interest us—we have our private opinion of statisticians—but this particular report, we repeat, intrigued us not a little and left us with many perplexing thoughts. Coming as it did in the midst of a critical period in the history of Chicago, a period in which the mayor of our great city was engaged in bloody conflict with King George and when the King's paid spies were said to be hiding in ambush behind every school room door, we naturally regarded with suspicion anything that smacked of a foreign nature. So it was with considerable trepidation that we opened this pamphlet, for how were we to know that King George himself might not be hiding behind the cover?

And what did we find? Well, King George cannot be as aggressive as our funny mayor makes him out to be, for there is little evidence of him in the report. As far as he is concerned, we are quite reassured. Some other matters, however, worry us considerably.

At the top of our lists of imports, for instance, stands crude petroleum which is imported to the extent of eight billion pounds. Now, is that nice? In such a refined country as this, is it right to import so much crude stuff? Think of the bad influence these crude oils will have upon our nice refined oils. In the same category, we find further down on the list, unrefined copper, imports of which increased 3.4 per cent. This, in our estimation, is an insult to our intelligence and the practice should be stopped at once. Certainly we have enough unrefined coppers in this country without importing more from foreign sources. The immigration authorities apparently are asleep on the job.

Palm oil, we find, was imported to the extent of 52 million dollars' worth. This is interesting since it indicates the enormous proportions of the handshaking industry in the United States. Half of this supply, no doubt, is delivered direct to the White House and the other half to the luncheon clubs of the nation. Local politicians, it appears, are bootlegging this product, and it is well, before shaking with them, to make certain that you are getting the genuine stuff.

Of concern to the Co-operative Morticians Association should be the marked decline in the importation of sulphuric and arsenious acids and in potassium cyanide. Imports of the latter, the first six months of 1927 were 17 per cent less than during the same period of 1926. An effort should be made to make the country more cyanide conscious. Perhaps a potassium cyanide day would help out.

Cork waste and shavings, we note, are sixtieth on the list with imports totaling $48,000,000 the first six months of this year. This is 49.5 per cent less than that imported over the same period last year, which leads us to believe that the breakfast food manufacturers are not doing as much business as formerly. It may be, however, that they have discovered new domestic sources of raw material. We hope so.

Importation of onions we find increased 50 per cent this year. This is encouraging although a recent experience in a New York subway gave us the impression that the increase was considerably more than that. How those folk do know their onions!

Steel bars, an item which we hardly expected to find, were imported to the extent of 128 millions dollars' worth. This is interesting because it shows modern development. The old bars before prohibition used to be made of mahogany but with the stuff that is being passed over them these days, mahogany no longer stands up and steel is necessary.

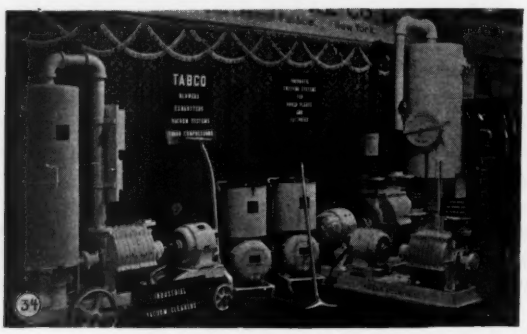
Another item about which something ought to be done is the importing of undressed furs. This is distinctly immoral—shocking, to say the least, and we refer the matter to the Methodist Board of Temperance, Prohibition and Public Morals for immediate action. Nothing that is not dressed should be imported.

We should like to comment further, for the report contains a great deal that is of interest but we are running close to the end of our page and our supply of rubber type is limited. We cannot close, however, without referring to our 2½ million dollar exports to Mozambique. This speaks well for the aggressiveness of our salesmen, for we understand that sales resistance stiffened considerably in Mozambique last year. It may also be of interest to know that we exported $1,045,000 worth of goods to Iraq. Isn't that fine? Iraq? Where is Iraq? Gosh! That's a sticker. As Milt Gross would say, "Dunt esk."

Power, Heating and Ventilating Exposition

PROGRESS IN UTILIZATION OF POWER FOR BENEFIT OF MANKIND WILL BE EPITOMIZED AT GRAND CENTRAL PALACE, NEW YORK, DECEMBER 5 TO 10

MORE AND MORE each year is power being utilized to relieve the drudgery in industrial operations, to increase the output per worker and to add to comfort and convenience in homes and factories. Over a period of 8 yr., the nation's prime mover capacity has increased 10,000,000 hp.; interconnected and extended systems of distribution have made power available in small towns as well as in large cities, so that industries are locating with reference to transportation and market and the conveniences and benefits of electricity are being made available to homes and farms outside of urban areas. Increase in industrial consumption of power has been 98 per cent and in household consumption 133 per cent over a period of 8 yr., the domestic service now reaching 68,000,000 people. In the last 3 yr. the increase in farms receiving electric service has been 86 per cent, largely due to the rapid extension of transmission and connecting lines, which has amounted to 40,000 miles in the last seven years.



It is interesting to note that, at the present time, electric light and power are available to every city of 5000 inhabitants and over, to 97 per cent of all towns with population between 1000 and 5000 and to 40 per cent of all villages with population between 250 and 1000. In addition to this, power used in individual industrial establishments has increased rapidly.

Transferring of power from one system to another has made possible great economies in the operation of plants, and the maintenance of continuous power supply during shortage of water or in case of accident to local plants. An important recent instance was the interconnection of power lines between Oklahoma, Mississippi, Tennessee, Arkansas and Louisiana which maintained lighting service in the flooded region even when local power houses were drowned out.

In the way of progress for comfort and convenience, mechanical air conditioning has done much to increase the efficiency of workers in factories. The supply of washed and filtered air, tempered by heating or by refrigeration to give comfort at all seasons has alleviated the discomforts of factory employment. In the home the use of ventilating systems, mechanical refrigeration and power devices for washing and cleaning has played its part in removing the drudgery of housekeeping.

All this has been accomplished primarily by improvements in equipment and operation of power plants which have made possible lower cost of power, wider power distribution and more effective means of using it. Notable among these improvements is the control of boiler room operation and the recording of the results. Master control of draft, rate of fuel feed and rate of water feed can be automatically regulated in accordance with the steam demands on the boiler and complete records of plant performance can be gathered on a single panel in the chief engineer's office.

Gathered in the Grand Central Palace at the exposition of Power & Mechanical Engineering will be found the latest devices and improvements which have contributed to all these results, and it is to be expected that progressive engineers and power plant executives will be found in great numbers studying these devices and how they may be utilized.

In the directory following will be found a summary of the features displayed in each booth. The Grand Central Palace is on Lexington Ave., New York, between 46th and 47th St. and can be easily reached by the Lexington Ave. surface line, by the East side elevated, or by the East side subway or, for those using the West side subway, the cross over at 42nd St. furnishes a convenient means. The exhibits will be open from December 5th to 10th, beginning at noon and remaining open until 11 o'clock each evening. Four floors will be utilized for the exhibit, booths 2 to 201 being found on the main floor, 201 to 347 on the mezzanine or second floor, 401 to 575 on third floor and numbers from 601 upward on the fourth floor.

SUMMARY OF EXHIBITS

ABSOLUTE CON-TAC-TOR CORP., Elkhart, Ind. Booths 478, 490; Third floor.

Complete set of the Lockswitch oil burner control system will be operating to show the sequence for safety features. Also automatic electrical temperature and pressure controls for oil burners, refrigerators, unit leakers, forced and induced draft fans. Con-Tac-Tor mercury switches will be demonstrated and the method for operating them.

ACCURATE BRASS CASTING CO., INC., Cooper and Wyckoff Aves., Brooklyn, N. Y. Booth 502; Third floor.

Brass and copper forgings and castings to close dimensions with demonstration of method of making castings.

ADVANCE ENGINEERING CO., 168 Washington St., New York, N. Y. Booths 28; First floor; 274, 275, 276; Second floor.

Main features in the mezzanine exhibit will be a glass model of the Armstrong steam trap working on steam pressure to show clearly its operation; also demonstration

of the removal of oil and water from air by the Gast compressed air separator and Armstrong air trap with a complete hook up of the Advance return system, featuring Templeton pumping and lifting traps. Other features displayed will be the Mosher steam and oil separator, Cadman blowoff valves and gate valves, and Chicago-Wilcox gaskets.

In Booth 28 a full line of Cash standard reducing and regulating valves will be displayed.

AEROFIN CORP., 750 Frelinghuysen Ave., Newark, N. J. Booth 14A; First floor.

Heating units with extended surface, made of non-corrodible material, arranged for use in units or in bank for indirect systems.

THE AIR PREHEATER CORP., 25 Broadway, New York, N. Y. Booths 234, 235; Second floor.

Here will be found a scene-in-action picture, showing the operation of the Ljungstrom preheaters, also models of preheaters with photographs and drawings illustrating the details of construction and installations which have been made by the company.

ALBAUGH-DOVER MFG. CO., 2100 Marshall Blvd., Chicago, Ill. Booth 674; Fourth floor.

This company will feature in its exhibit spur gear and worm gear speed reducers, also high grade cut gears, the gear reducers being shown in actual operation. A special feature will be a spur gear speed reducer with ball and roller bearings, driven under power by a ¼-hp. ball-bearing motor, the reduction ratio being 800,000 to 1.

ALEXANDER BROS., 14 South St., Philadelphia, Pa. Booth 625; Fourth floor.

Here will be shown Tentacular transmission belt, illustrating, by a drive in actual operation the effectiveness of this method of transmission.

A. ALLAN & SON, Harrison, N. J. Booths 485, 486; Fourth floor.

Here will be shown application of Allan Red metal to pistons of Diesel, Uni-flow and Corliss engines and of air compressors; also Allan Red metal bushings, both cored and solid, and metal discs for globe valves in high pressure and high temperature service. Packing rings will be shown for locomotive piston rods, valve stems and air pump rods.

ALLEN & BILLMYRE CO., INC., Grand Central Palace, New York, N. Y. Booths 491, 492; Third floor.

A heavy duty Tabco pneumatic sweeping system for power plant installations, such as used in many plants throughout the country will be on exhibition in practically constant operation. It will demonstrate the great power and capacity of the system for heavy duty industrial suction sweeping. In addition will be shown several sizes and types of portable sweeping equipment for general service connected and available for actual demonstration at any time. Included in the exhibit will be several sizes of centrifugal air turbo blowers and exhausters of both single and multi-stage types.

THE ALLEN-SHERMAN-HOFF CO., 225 S. 15th St., Philadelphia, Pa. Booth 75; First floor.

Two scene-in-action pictures will be shown illustrating the company's Hydrojet system of ash handling. The first will illustrate a double water wall furnace bottom with ash hoppers and gates beneath and the Hydrojet system below that; the general arrangement being that of Boiler No. 22 at the Calumet Station, except that the Hydrojet system beneath the ash gates is added. The second picture will show ashes being discharged to a sump, then pumped into an ash storage tank and collected by truck, also indicating how ashes could be pumped for filling in about the property.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Booths 516, 517, 518; Third floor.

Turbines, steam and gas engines, electrical machinery, pumps, air compressors and power transmission equipment will be shown in this exhibit, also special machinery for mining and metallurgical work.

AMERICAN ABRASIVE METALS CO., 50 Church St., New York, N. Y. Booths 730, 731; Fourth floor.

Anti-slip walkway surface materials including Feralun, Bronzalun and Alumalun, as used for stair treads and platforms, floor plates, elevator thresholds and door saddles will be exhibited. These are made by mixing Alundum in granular form with iron, bronze or aluminum to give the foot a firm hold.

AMERICAN AIR COOLED BLOCK ARCH COMBUSTION CO., 52 Vanderbilt Ave., New York, N. Y. Booth 567; Fourth floor.

Application of the A B C system of blocks for construction of air cooled flat suspended arches, also for the building of side walls, roof arches and industrial furnaces. Photographs of installations for water-tube boilers and demonstration of replacement of blocks. Air Preheating Systems.

AMERICAN ARCH CO., INC., 17 E. 42nd St., New York, N. Y. Booth 58; First floor.

Construction of suspended arches with interlocking pillar tiles, suspended by steel clips to angle iron supports.

AMERICAN BLOWER CO., 6000 Russell St., Detroit, Mich. Booths 319, 320, 321, 322; Second floor.

The Sirocco flue dust collector for removing fly ash from the exhaust gases of powdered fuel plants to prevent deposition of this ash on the surrounding buildings will be shown, also working models of this collector. Other features will be the company's regular line of fans, blowers and exhausters. A new catalog will be distributed.

AMERICAN BRASS CO., Waterbury, Conn. Booth 65; First floor.

Copper, brass, bronze and nickel silver products in sheets, wire, rods and tubes will be displayed, also Anaconda copper and brass products in tubes for condensers and hot water plants, metal hose, turbine blading, valve diaphragms and piston rods, bus bars, bus tubes, wire, cable and hollow conductors, non-ferrous welding rods, Everdur metal of manganese silicon bronze, also products and extruded and die-pressed parts of copper, brass and bronze. A special feature will be the Anaconda seamless connector for splicing wire and cable in the field.

AMERICAN CAR & FOUNDRY CO., 30 Church St., New York, N. Y. Booth 201; Second floor.

Berwick electric metal heaters will be featured in this exhibit, including a No. 3 three-electrode electric rivet heater, a one-electrode metal heater for upsetting or forging work and a 4-ft. model of a 20-ft. bar heater.

AMERICAN ENGINEERING CO., Philadelphia, Pa. Booth 298; Second floor.

Lo-Hed electric hoist in ¼ t. size and other sizes which are made up to 24,000 lb. capacity.

AMERICAN FOUNDRY EQUIPMENT CO., 366 Madison Ave., New York, N. Y. Booth 448; Third floor.

Castings for high pressure and temperature work will be displayed in this booth.

AMERICAN MACHINE & FOUNDRY CO., 5520 Second Ave., Brooklyn, N. Y. Booths 423-428; Third floor.

Here will be found apron feed and automatic sacking scales made by the Automatic Weighing Machine Co., a division of the American Machine & Foundry Co. Other features will be rotary high speed direct drive pumps and methods of wrapping packages automatically.

AMERICAN PIPE BENDING MACHINE CO., INC., 37 Pearl St., Boston, Mass. Booths 770, 771; Fourth floor.

Demonstration of Wonder pipe bending machines in operation for making cold pipe bends, the exhibit including both hand and motor-operated machines.

AMERICAN SCHAEFFER & BUDENBERG CORP., Brooklyn, N. Y. Booth 74; First floor.

American industrial instruments for indicating, recording and controlling temperatures, pressures and speed will make up this display. This will include pressure gages, pop safety and relief valves, steam traps, indicating, dial and recording thermometers, tachometers, recording gages, electric temperature controllers and pressure controllers.

AMERICAN STEAM PACKING CO., 514 Atlantic Ave., Boston, Mass. Booth 666; Fourth floor.

Sheet and rod packings for all purposes.

THE AMERICAN WELL WORKS, Aurora, Ill. Booth 662; Fourth floor.

Types of centrifugal and deep well pumping machinery will be shown, with separate parts to show construction and views to show installation.

ANDALE ENGINEERING CO., 1600 Arch St., Philadelphia, Pa. Booth 214; Second floor.

This company will make its usual display of duplex and other types of water and oil strainers, also a new line of oil coolers in various types and sizes with cuts and models to show the method of construction and operation. Steam purifier for removing moisture from steam inside the boiler.

ANDREWS-BRADSHAW CO., 530 Fourth Ave., Pittsburgh, Pa. Booth 17; First floor.

Tracyfiers of latest construction at work removing moisture from steam under conditions duplicating those of actual boiler operation. Disassembled Tracyfier to show details of construction and operation.

ARMSTRONG CORK & INSULATION CO., 24th and A. Z. Railroad, Pittsburgh, Pa. Booths 215, 216; Second floor.

High temperature insulating materials for steam piping and equipment, also insulation for refrigerating plants.

ARMSTRONG MACHINE WORKS, Three Rivers, Mich. Booth 275; Second floor.

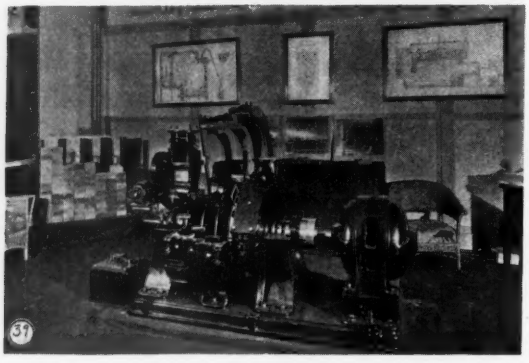
Complete lines of steam traps for ordinary and high-pressure service. Steel traps for 650 and 900 lb. pressure. No. 50 compound trap for large quantities for water at high-pressure from separators and purifiers. The principle of the submerged, inverted bucket will be demonstrated by a glass trap, operating under steam pressure, so that the observer can see how air is handled without air-binding or waste of steam; how quick valve action eliminates wire drawing; how dirt and sediment are handled. Regular traps will be demonstrated operating by compressed air as in draining oil and water from air lines.

ASHTON VALVE CO., 161 First St., Cambridge, Boston, Mass. Booth 38; First floor.

Complete line of Ashton pop, safety and relief valves will be shown, also pressure and vacuum gages in indicating and recording type. Everlasting specialties, including Dead-weight gage testers will be included. Special features will be the company's high capacity pop safety valves to operate on 600 lb. with superheated steam of any temperature. Also the 40-in. No. 100 master pilot gage with double illuminated dials and the No. 79 Dead-weight gage tester operating on single or double area.

E. C. ATKINS & CO., 402 S. Illinois St., Indianapolis, Ind. Booth 631; Fourth floor.

Demonstration will be made of metal cutting machines in operation Kwik-Kut and the No. 7 power hacksaw machines, also metal cutting bandsaw machine. In addition will be shown the Silver-Steel power hacksaw blades and a line of small tools, such as hacksaw frames, circular saws and the like.



ATLANTIC GEAR WORKS, 16 Jefferson Ave., Brooklyn, N. Y. Booth 626; Fourth floor.

Cast and cut gears for all uses and in all shapes.

ATLAS VALVE CO., 282 South St., Newark, N. J. Booth 612; Fourth floor.

Capitol feed water regulator in actual operation, regulating the feed to a 3-hp. boiler at 100 lb. pressure. Simplicity and accuracy of feed water control will be illustrated by means of the plant which will include feed water pump and feed water heater.

ATWOOD & MORRILL CO., Salem, Mass. Booths 552, 553; Third floor.

New damper regulator of special design, also valves for high temperature and pressure work in turbine and condenser installations and special valves for low pressure superheating work.

BABBITT STEAM SPECIALTY CO., 55 S. Water St., New Bedford, Mass. Booth 90; First floor.

Special design of chain operated rims for application to overhead valves.

THE BABCOCK & WILCOX CO., 85 Liberty St., New York, N. Y. Booth 54; First floor.

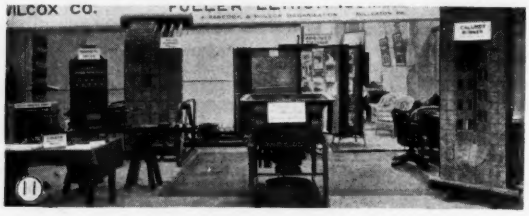
Sections for forged steel headers will be shown, built for pressures of 200 to 1450 lb., also special forged steel drum nozzles of various designs and sizes. Sections of forged steel superheater boxes will be displayed, also drum rivets in various stages of manufacture, high pressure gage glasses and other fittings. In addition will be seen a Babcock & Wilcox mechanical atomizing oil burner fitted with the company's No. 80 high grade furnace brick. Special shapes of this brick will also be shown. Of interest will be a display of Enduro and Toncan iron superheater and economizer tubes as made by the Babcock & Wilcox Tube Co., with test specimens which have been subjected to corrosive action of various agents and sections of steel and iron tubes which have had similar treatment.

E. B. BADGER & SONS CO., Boston, Mass. Booth 436; Third floor.

Badger expansion joints of self-equalizing corrugated type and also non-clog spray nozzles for cooling ponds will be included in this exhibit.

BAILEY METER CO., 2013 E. 46th St., Cleveland, Ohio. Booth 51; First floor.

Boiler meter panel boards in various styles and sizes and complete line of Bailey boiler meters, electrically and mechanically operated, fluid meters, pressure and temperature recorders, tachometers and multi-indicating gages. Bailey meter control for automatically regulating the supply of fuel



and air to the boilers according to demand for steam and in proportions for best combustion efficiency will be demonstrated, to show simplicity and flexibility.

THE BALLWOOD CO., 50 Church St., New York, N. Y. Booth 346; Second floor.

Special pipe joints including forged hammer welded Van Stone joints, also pipe fabrications for seamless steel piping in sizes from ¾ to 6-in. and for pressures up to 600 lb.

BARCO MANUFACTURING CO., 1801 Winnemac Ave., Chicago, Ill. Booth 515; Third floor.

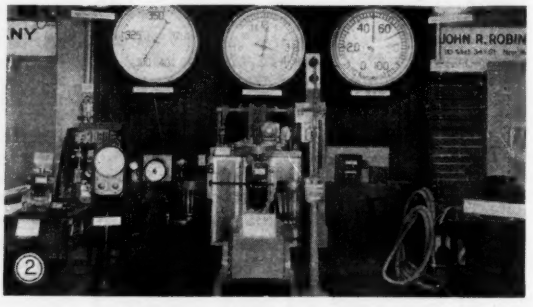
Working models will be shown of the Barco balanced and lubricated plug valves for various services and, in addition, models of Barco flexible joints for making connection at any angle.

BARNES & JONES, 128 Brookside Ave., (Jamaica Plain) Boston, Mass. Booths 312, 313; Second floor.

Products included in this exhibit will be the modulation, vapor and vacuum form of heating systems, also as steam specialties, traps of thermostatic radiator, vacuum return, blast, boiler return and vent types and modulation valves for steam and water heating systems.

BARTLETT HAYWARD CO., Baltimore, Md. Booth 529; Third floor.

Fast's flexible couplings will be shown with detailed parts to illustrate the all-metal, double engagement positively lubricated action which takes care of misalinement without the use of flexible materials. The design of two spur gears, one on each shaft continuously meshed will be illustrated by



mounted sectionalized models and photographs as applied to drives in various industrial operations.

BAYER CO., 4067 Park Ave., St. Louis, Mo. Booth 347; Second floor.

Details of soot blowing system with action of valve-in-head control and adaptation of soot blowers to all types of boilers.

BEARINGS INDUSTRY CORP., 1834 Broadway, New York, N. Y. Booth 482; Third floor.

This company will exhibit ball bearings, roller bearings of both taper and cylindrical type and steel balls. The bearings are interchangeable in size with others and for use in general automotive and industrial work.

BEARIUM BEARINGS, INC., 32 Broadway, New York, N. Y. Booth 524; Third floor.

Rough and machined bearings for all types of service will be shown and demonstration made of non-seizing of these metals at high speeds.

R. H. BEAUMONT Co., 319 Arch St., Philadelphia, Pa. Booth 50; First floor.

Working model will be shown of the super-central system of coal and ash handling. Briefly, this consists of a counterweighted coal skip hoist, tram car, suspension bunker, weigh larry, pivoted ash gates and cable drag scraper. Demonstration of the operation of the system will be made continuously.

BERNITZ FURNACE APPLIANCE Co., 80 Federal St., Boston, Mass. Booth 78; First floor.

Bernitz carborundum water wall blocks for covering water wall tubes on the fire face to aid in maintaining high furnace temperatures and resist flame and mechanical abrasion. Complete section of a typical water wall equipped with these blocks will be on exhibit, also ventilated types of construction, using carborundum boiler furnace block.

BETHLEHEM STEEL Co., Bethlehem, Pa. Booths 70, 71; First floor.

Main feature of this exhibit will be a full size No. 2 Bethlehem pulverizer in operation, a Bethlehem Diesel engine and a demonstration model of the new Bethlehem torque amplifier and backlash eliminator for securing amplification of power with absolute synchronism. Other features in the exhibit will be power plant auxiliaries, such as the Bethlehem Dahl oil burning system with Bethlehem Weir type boiler feed pumps and samples of charcoal iron boiler tubes.

BIAX FLEXIBLE SHAFT Co., 20 E. 17th St., New York, N. Y. Booth 474; Third floor.

Flexible shaft machines will be exhibited in this space, mounted for overhead suspension, floor stand, floor truck and bench base service. These will range in size from $\frac{1}{4}$ to 5 hp. and will be shown under working conditions transmitting up to 5 hp. Different sizes of Biax shafts will be shown with standard fittings for attaching to various motors.

THE BIGELOW Co., New Haven, Conn. Booth 68; First floor.

Main features of this exhibit will be large drawings showing the most recent designs and development of Bigelow-Hornsby boiler and Bigelow fire-tube boilers including the horizontal return tubular and two-pass types. Construction will be illustrated by literature, blueprints and photographs of these types and also of the Bigelow-Manning boiler and the Bigelow electric steam generator.

L. C. BIGELOW Co., INC., 250 W. 54th St., New York, N. Y. Booth 750; Fourth floor.

Products of the William Ganschow Co. of Chicago, including planetary speed transformers and worm gear reducers with application to power plant apparatus. Also Wearever production tools, made by Scully Steel & Iron Co. of Chicago with demonstration of their use.

BLAW-KNOX Co., Farmers Bank Bldg., Pittsburgh, Pa. Booth 618; Fourth floor.

Clam shell buckets for industrial uses.

BOIG & HILL, INC., 180 Washington St., New York, N. Y. Booth 10; First floor.

Curtis engineering specialties including pressure regulators, damper regulators, traps, water and temperature regulators.

BOILER ENGINEERING Co., 931 Federal Trust Bldg., Newark, N. J. Booth 450; Third floor.

Beco baffle wall will be shown in full size section, illustrating the self-supporting feature and simple design. Positive expansion joints and sheet metal separators.

BOND FOUNDRY & MACHINE Co., Manheim, Pa. Booth 611; Fourth floor.

Demonstration of truck casters for industrial and power plant trucks of all types, fitted with different designs of wheels for the lightest to the heaviest loads.

THE BORDEN Co., Warren, Ohio. Booth 459; Third floor.

This company will exhibit its entire line of Beaver tools and power drives for cutting and threading pipe. Beaver power drive and No. 70 series die stocks especially adapted for power drive will be special features of the exhibit. Demonstration of the operation of tools will be made.

BOSTON GEAR WORKS SALES Co., Norfolk Downs, Mass. Booths 340, 341, 342; Second floor.

Standardized speed reduction units and Boston silent chain drives with hardened ground-tooth spur gears.

BOTFIELD REFRACTORIES Co., Philadelphia, Pa. Booth 325; Second floor.

The new Adamant gun will be shown as used for applying refractory coatings on boiler settings. These coatings are composed of Adamant fire brick cement and Adachrome, which is a chemically neutral refractory material highly resistant to the attack of clinker and other destructive elements.

S. F. BOWSER & Co., INC., Ft. Wayne, Ind. Booth 739; Fourth floor.

Lubrication, oil filtration and oil storage systems, including the Bowser and Richardson-Phenix apparatus with demonstration of operation of complete systems.

BRADLEY WASH FOUNTAIN Co., Milwaukee, Wis. Booth 247; Second floor.

Washroom equipment suitable for factory and power plant installation.

BRIDGEPORT BRASS Co., Bridgeport, Conn. Booth 243; Second floor.

Brass, copper and bronze sheet rod and tube forms for condenser and heater construction, also pipe and pipe fittings in brass and copper, bronze alloy trolley wire and samples of special brass construction.

BRISTOL Co., Waterbury, Conn. Booth 12; First floor.

Complete line of recording and indicating instruments for the power plant, including pressure and vacuum gages, thermometers, pyrometers, water level gages, electrical instruments, such as voltmeters, ammeters and wattmeters will be found in this exhibit. Special features will be recording thermometers for feed water and flue gas temperatures; pyrometers for Diesel engine applications; liquid level gages for tanks and for boilers.

BROWN INSTRUMENT Co., Philadelphia, Pa. Booth 34; First floor.

Brown meter equipment will be the theme of the display, including indicating and recording models. Connected to a manometer, these can be actuated by visitors to create pressure differentials and demonstrate the sensitiveness and responsiveness to variations in flow, the flow meters having automatic recording planimeter and integrator. Indicating and recording pyrometers, CO_2 meters, gages, thermometers and tachometers will be shown. On the main display panel will be a large model of the circular chart type of flow meter mechanically operated to show the outstanding features of this equipment, which operates on the inductance bridge principle. Also large reproductions to demonstrate the success and wide use of this meter.

BUFFALO FORGE Co., Buffalo, N. Y. Booth 2; First floor.

Mechanical draft apparatus, including forced and induced draft fans will be shown; also blowers for pulverized coal plants, ventilating fans, and the Carrier system of generator cooling.

BUFFALO STEAM PUMP Co., Buffalo, N. Y. Booth 73; First floor.

Centrifugal pumps for high heads with single stage operation will be displayed, also a single stage, single suction pump of centrifugal design and multi-stage pump of double suction type with horizontally split casing.

BUILDERS IRON FOUNDRY, 9 Codding St., Providence, R. I. Booth 276, 277; Second floor.

Venturi meter equipment will be shown in the latest form and demonstration made of the use of the meter for boiler feed water, turbine condensate, cooling water and the like. Cast steel meter tubes for pressures up to 1000 lb. and cast iron tubes for low pressure will be shown with a radial planimeter for obtaining totals from venturi charts.

BUNDY STEAM TRAP Co., Nashua, N. H. Booth 8; First floor.

Entire line of Bundy steam traps will be shown, with special application for various conditions. Details will also illustrate the ground joints at various connections, knife-edge bearings to reduce friction, monel valve seats and discs and shock absorbing attachments for quiet operation.

EDWIN BURHORN Co., Foot West 5th St., Bayonne, N. J. Booth A; First floor.

Model will be shown of the Burhorn Smaltower in operation, demonstrating the water distribution, air circulation and other details. Photographs will be shown of various installations and of the use of these cooling towers for Diesel engine jacket water, air compressor cooling water and for refrigeration, cold storage and ice making plants.

A. M. BYERS Co., 235 Water St., Pittsburgh, Pa. Booth 442, 443; Third floor.

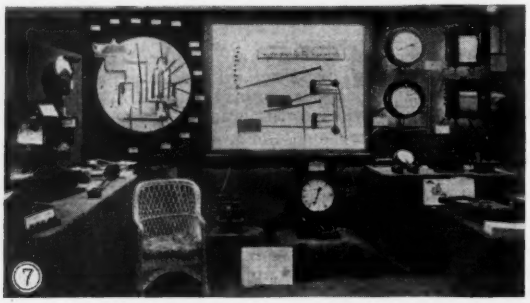
Samples of genuine wrought iron pipe showing its resistance to corrosion under severe service conditions and examples of methods recently perfected for making Van Stone joints in wrought iron pipe will be features worthy of special attention. The special spiral red stripe marking for identifying Byers pipe and methods of manufacture will be illustrated.

ANDREW C. CAMPBELL, INC., Bridgeport, Conn. Booth 660; Fourth floor.

Nibbling machine in operation for working out shapes from metal plate up to ⅜ in. thick. Machines will be shown for light plates up to No. 14 gage, for medium plates to ¼ in. thick and for heavy plates to ⅜ in. thick.

THE CARBORUNDUM CO., Perth Amboy, N. J. Booth 22; First floor.

This company's principal exhibit will be a section of water-tube side walls for boiler furnaces, protected with Carbofrax refractory facing with streamers indicating the temperature drop at various points through the structure. In



addition will be displayed a general line of Carbofrax, Aloxite and Infrax refractory brick and shapes in various types and for various furnace use. Included will be air-cooled Carbofrax blocks as manufactured for the Bernitz Furnace Appliance Co. for boiler settings and water gas generator linings.

CARR FASTENER CO., Dot Lubrication Division, 31 Ames St., Cambridge, Mass. Booth 744; Fourth floor.

Complete line of devices for lubricating industrial machinery including Dot guns and nipples, pressure cups, centralized lubricating system and electric lubricating tank. Illustration of method used in analyzing requirements of a plant and arranging lubricating system to reduce expense to a minimum.

CARRICK ENGINEERING CO., 538 S. Clark St., Chicago, Ill. Booth 295; Second floor.

Master control for furnaces will be demonstrated by a working model with glass enclosure. The equipment will include chronometer valves, furnace regulators and master control with mercury column in place of spring.

CARRIER ENGINEERING CO., 7501 Frelinghuysen Ave., Newark, N. J. Booth 14-A; First floor.

Heating and ventilating systems for buildings and industrial plants with air conditioning service, also equipment for generator cooling.

THE CASEY-HEDGES CO., Chattanooga, Tenn. Booth 343; Second floor.

In this exhibit will be found a working model of the company's multi-pass boiler, also descriptions of various types of boilers made by the company and samples showing the method of construction of heavy plate work.

A. W. CASH CO., Decatur, Ill. Booths 28; First floor; 276; Second floor.

Combustion control by the Craig system with master controller operated by steam pressure. Forced draft fans, boiler uptake dampers and models of the pressure regulating devices of this company.

CELITE PRODUCTS CO., 1320 S. Hope St., Los Angeles, Calif. Booth 14; First floor.

In this exhibit the principal features will be demonstration on a furnace partially insulated and partially un-insulated to show the difference in heat radiation losses between these two constructions. In addition a large Sil-O-Cel insulating brick will be shown, also conductivity charts, samples of insulated construction and photographs of power plants where Celite products have been used. Detailed displays will be of the Sil-O-Cel insulating brick, insulating powder, cement and block, and the C-3 aggregate for making insulating concrete, used in doors and panels.

CENTRIFIX CORP., 3029 Prospect Ave., Cleveland, Ohio. Booths 302, 303; Second floor.

Complete line of purifiers and live steam separators for purification of steam, air, gas and vapor.

CENTURY ELECTRIC CO., 1806 Pine St., St. Louis, Mo. Booths 712, 713; Fourth floor.

Century automatic starting induction motors for 2 and 3 phases, designed for low starting current and low temperature.

CHAPMAN VALVE MFG. CO., 203 Hampshire St., Indian Orchard, Mass. Booth 2; First floor.

Chrome nickel steel gate valves and fittings for high pressure and temperature service, motor unit for operation of large valves and a full line of iron body gate valves for water and steam service. Brass valves for general service and report on the company's research work on materials for piping systems and strains in flange joints.

CHICAGO CHEMICAL CO., 6216 W. 66th Pl., Chicago, Ill. Booth 693; Fourth floor.

Here will be shown an exhibit of K. W. S. sodium aluminate and testing kits to demonstrate the method of treating boiler feed water, both directly in the boiler and in conjuncion with lime and soda ash treating plant.

CHICAGO PIPE THREAD MACHINE CO., Racine, Wis. Booth 472; Third floor.

No. 2 power pipe threading machine with automatic opening die head, three speeds for fast operation and high speed precision thread steel dies. A machine that can be used either as a portable machine or for maintenance or construction work.

CHICAGO PUMP CO., 2336 Wolfram St., Chicago, Ill. Booths 636, 637, 638, 639; Fourth floor.

Centrifugal pumps and their application to power plant uses including bilge pumps, vacuum pumps, condensation pumps and receivers, boilers feed and general service pumps.

CHICAGO WILCOX CO., 77th and Anthony Sts., Chicago, Ill. Booth 274; Second floor.

Gaskets with U-shaped metal cover and filling of abestos rubber or leather.

CLARAGE FAN CO., Kalamazoo, Mich. Booths 244, 245; Second floor.

Exhibit here will consist of a new Clarage humidifier and a Clarage unit heater, both in operation. The unit heater consists of either cast iron or coil heating unit with combined motor and fan. The humidifier is of a new design, particularly adapted for the small job where low cost is essential.

CLEMENTS MFG. CO., 601 Fulton St., Chicago, Ill. Booth 773; Fourth floor.

Clements-Cadillac portable electric blower and vacuum cleaner for factory and power plant dust removal.

CLIPPER BELT LACER CO., Grand Rapid, Mich. Booth 551; Third floor.

Clipper belt lacers, fasteners or hooks, connecting pins and belt cutters will be shown. A special feature will be a speed lacer to lace both ends of an 8-in. belt in 1½ min. A scene-in-action display will be the clipper ship sailing across the sea, an attractive electric display.

COCHRANE CORP., 17th and Allegheny Sts., Philadelphia, Pa. Booth 67; First floor.

Deaerating heater with vent condenser for operation under vacuum, back pressure or atmospheric pressure; Strainerless conical filter; indicating, recording and integrat-

ing flow meter with pressure and temperature recorded on the same chart; multiport back pressure valve with separate regulation of the several discs; steam and oil separators and traps for high or low pressures. Chemical proportioner and agitator for hot process water softener.

COEN CO., INC., 112 Market St., San Francisco, Calif. Booth 15-B; First floor.

Oil heating and burning systems and apparatus.

COFFIN VALVE CO., Tolman St., Boston, Mass. Booths 408, 409; Third floor.

Ten-inch Chapman gate valve operated by Kelty motor-drive unit. Dow disc arm pivot valve with hydraulic operation having automatic solenoid operated control serving as check valve on pump discharge line. Hydraulic cylinder with solenoid operated controlling valve for remote operation.

COMBUSTION SALES CO., INC., 153 E. 42nd St., New York, N. Y. Booth 728; Fourth floor.

The exhibit of this company will be the C-E-Z furnace fire observation window for installation in the wall of a furnace permitting the operator to examine the condition of the fire in comfort at all times.

COMBUSTION SERVICE CORP., 25 Beaver St., New York, N. Y. Booths 716, 717, 732, 733; Fourth floor.

Tri-fuel burners for coal, oil or gas with air control giving long or short flame. Burners for pulverized coal in capacity from 200 lb. to 4000 lb. an hour per burner, gas burners and oil burners of mechanical atomizing design.

CONNERY & CO., 2nd St. above Erie Ave., Philadelphia, Pa. Booth 43; First floor.

Sections will be shown of the company's breechings with improved expansion stiffener and welded joints. A feature will be improved methods of covering and breeching, covering attachments, also a new air-cooled damper and expansion stiffener stack connections.

CONSOLIDATED GAS CO. OF NEW YORK, 130 E. 15th St., New York, N. Y. Booth 613; Fourth floor.

Combined exhibit of Brooklyn Boro Gas Co., Brooklyn Union Gas Co., Kings County Lighting Co., Consolidated Gas Co. and New York & Richmond Gas Co., showing uses of gas in industry, in operative exhibits, where possible, to demonstrate methods of application.

CONTINENTAL VALVE & EQUIPMENT CO., Framingham, Mass. Booth 316; Second floor.

Exhibit will be made of forged steel pipe fittings, steel unions, flanges and of governors. The line of fittings and unions is of the Framanco brand, the unions having double tight joints.

COOPER-HEWITT ELECTRIC CO., 95 River St., Hoboken, N. J. Booth 504; Fourth floor.

Lighting systems for industrial plants to mitigate eye strain. Kon-nec-tor mercury break switches for automatic control.

CORK FOUNDATION CO., 315 Fifth Ave., New York, N. Y. Booths 760, 761; Fourth floor.

Cork foundation mats for absorbing vibration and noise of all types of machinery.

CHARLES CORY & SON, INC., 183 Varick St., New York, N. Y. Booths 241, 242; Second floor.

Equipment will be found in this booth for signalling, communicating, lighting and control. Products specially featured will be Robinson interlocks, seamless flexible metal hose, Cory signal systems and anti-noise telephones. Other apparatus included will be ohmmeters, flow meters, water level indicators, fire, temperature and pressure alarm systems, valve, window and door operating devices, lighting fixtures, wiring appliances, motors and switchboards.

CRANDALL PACKING CO., Palmyra, N. Y. Booth 755; Fourth floor.

Raw materials as used in the manufacturing processes, and also the finished product of this company in the form of steam, water, gas, air and ammonia packings will be shown, the list of material including rod packings made from asbestos and compressed sheet, packings made from duck and rubber, flax, gaskets of all kinds and a line of metallic packings.

CRANE CO., 836 S. Michigan Ave., Chicago, Ill. Booths 52; First floor; 462, 463, 464; Third floor.

Cast steel gate valves for pressures up to 900 lb., also valves of materials other than steel in gate, globe, angle and other forms. Special design trimmed with stainless steel for superheated steam service and with bodies shaped to give uniform section of metal. Receiver type steam separators with cast steel head and shell of steel pipe, all joints being welded.

CROSBY STEAM GAGE & VALVE CO., 10 Roland St., Charlestown, Mass. Booth 98; First floor.

Valves of bronze, monel, steel and Nickeloy in globe and gate form, also machines for testing gages up to 25,000 lb. Special relief valves of monel metal and of cast steel for pressures up to 900 lb.

CROUSE-HINDS CO., Syracuse, N. Y. Booth 610; Fourth floor.

Wire and wiring conduits with special feature of the new Obround condulets fitting.

CUTLER-HAMMER MFG. CO., 530 Grand Ave., Milwaukee, Wis. Booths 454, 455; Third floor.

Motor starting and controlling equipment for a.c. and d.c. motors including across-the-line starters, primary resistor starters and auto-transformer starters. The different types will be shown in both hand-operated and automatic starting form.

THE CUTTER ELECTRICAL & MFG. CO., 19th and Hamilton Sts., Philadelphia, Pa. Booth 701; Fourth floor.

This exhibit will consist entirely of air carbon circuit breakers for use in connection with systems having 700 volts or less, either alternating or direct current. A chief feature will be a 40,000-amp. circuit breaker solenoid operated for 525 v. direct current, which is non-closable on overload or on short circuit at any point of the solenoid closing stroke. Also will be shown a 1000-amp., three-pole, double-throw automatic transfer switch as used in auditoriums and theaters where a continued source of power is required; and U-Re-Lites, which are I-T-E circuit breakers enclosed within a steel box in capacities up to 1000 amp. at 3 phase, 440 v.

DAMPNEY CO. OF AMERICA, Hyde Park, Boston, Mass. Booth 248; Second floor.

Protective coatings of Apexior brand for preventing corrosion on surfaces of power plant equipment including boilers, economizers and feed water heaters. Power operated simple brush equipment for application of these coatings in drums and tubes. Boiler tubes, pickled to remove scale and coated with Apexior after long service under operating conditions.

M. T. DAVIDSON CO., 154 Nassau St., New York, N. Y. Booths 36, 37; First floor.

Sample exhibits of various sizes and working models of various types will be shown demonstrating the Davidson line of steam and centrifugal pumps. Included in the exhibit will be simplex steam pumps for light and heavy pressure, boiler feeding and tank work; also centrifugal pumps of single and multi-stage design for boiler feed, tank supply, brine circulation and other use. A vertical submerged sump pump for water and sewage service will be demonstrated.

G. M. DAVIS REGULATOR CO., 422 Milwaukee Ave., Chicago, Ill. Booth 267; Second floor.

Pressure regulation, control and relief equipment, also back pressure valves for service systems, non-return valves, heater traps for condensate return, float valves and a wing disc non-return valve for use as check valve without drop in pressure.

DAVIS ENGINEERING CORP., 90 West St., New York, N. Y. Booths 415, 416; Third floor.

Feed water heaters, storage water heaters, filter and grease extractors, waste heat boilers and non-return steam traps.

DEARBORN CHEMICAL CO., 310 S. Michigan Ave., Chicago, Ill. Booth 13; First floor.

Here will be found an interesting exhibit explaining the Dearborn method of boiler feed water analysis and treatment, also samples and data in regard to performance of No-Ox-Id rust preventive and information on lubrication, showing the progress from tallow to Dearborn oil.

DE BOTHEZAT IMPELLER CO., INC., 1922 Park Ave., New York, N. Y. Booth 769; Fourth floor.

Disc fans designed to develop high static pressure with high efficiency will be the special feature. Included will be a belt-driven 42-in. fan for silent operation, a 30-in. fan for industrial applications, a Bifurcator having 24-in. pressure fan inside the duct with motor outside, double disc mining fan for high-pressure ventilation, 8-in. forced draft fan, air filter unit with 18-in. pressure fan. Demonstration apparatus will show the high static pressure attained.

DELAVAL SEPARATOR CO., 165 Broadway, New York, N. Y. Booths 536-539; Third floor.

Crankcase oil reclaiming outfit, methods for purifying transformer oil and demonstration of the operation of the system.

DELAVAL STEAM TURBINE CO., E. Clinton St., Trenton, N. J. Booths 540-543; Third floor.

Worm and gear type reduction drives with ball bearings, giving, with single reduction, ratios of 100 to 1 and, with double reductions, 8000 to 1. Helical gears for speed reduction or increase, test of motor-driven pump with complete measuring apparatus, also the DeLaval velocity stage turbine.

DE LAVERGNE MACHINE CO., Ft. of 138th St., New York, N. Y. Booth 760; Fourth floor.

Diesel engines of solid injection type, ammonia compressors, ammonia condensers and raw water ice-making system.

JULIAN D'ESTE CO., 45 Washington St., N., Boston, Mass. Booth 10; First floor.

Curtis Engineering specialties, including regulators for steam, air, water and gas; also combustion controls and traps in float, bucket, expansion and return type.

M. H. DETRICK CO., 140 S. Dearborn St., Chicago, Ill. Booth 94; First floor.

Full size models will be shown here of the Detrick arch and Detrick sectionally supported wall, the latter being of air-cooled type, as installed in many large pulverized fuel installations. The company expects to have a new catalog ready showing description and cuts of up-to-date designs of furnaces in conection with stokers and pulverized fuel equipment. Also blueprints and cuts of installations will be shown in the booth.

DETROIT STOKER CO., General Motors Bldg., Detroit, Mich. Booths 203, 204, 205; Second floor.

Demonstration of the operation of the Detroit stoker showing the application of multiple retort design to underfeed practice; also worm gear drive with adjustable stroke of pusher rod.

DEWATERS SAFETY LATCH CO., 110 W. 40th St., New York, N. Y. Booth 263; Second floor.

Three different models will be shown of the DeWaters safety latch mounted on stands so that they can be opened and shut to demonstrate their operation. Working models will be mounted on iron firing doors with latches attached as used on a boiler and arranged to show the unfailing operation of the latch under any conditions of closing.

DIAMOND POWER SPECIALTY CO., 956 Oakland Ave., Detroit, Mich. Booth 16; First floor.

Soot blowers for rear end of return tubular boilers and for special application to water-tube boilers with valve-in-head control and patented barriers for protecting the unit. Portrayal of story of soot and ash deposits in boilers and methods of removal.

WALTER S. DICKSON, 11 Park Pl., New York, N. Y. Booths 232, 233; Second floor.

Heating and ventilating specialties, including control valves, air and steam traps and equipment for the handling of condensation.

JOS. DIXON CRUCIBLE CO., Monmouth St., Jersey City, N. J. Booth 254; Second floor.

Graphite and graphite greases, also graphite paints, pipe compounds and other products for lubricating and protective uses.

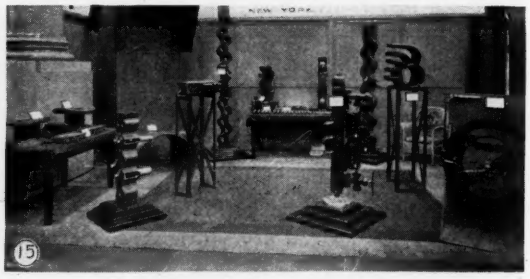
DODGE MFG. CO., Mishawaka, Ind. Booths 465, 466, 469, 470; Third floor.

Equipment for power transmission including split pulleys with wood bushings, hanger shafting and rope drive equipment.

DRAKE NON-CLINKERING FURNACE BLOCK CO., 5 Beekman St., New York, N. Y. Booths 227, 228; Second floor.

This company will feature the Drake non-clinkering S. X. air-cooled wall in fire clay, which is a new design to furnish highly preheated air while keeping the face of the tile at low temperature. In addition to these blocks, the Drake Armor Clad water wall and power burner for pulverized fuel will be exhibited.

C. A. DUNHAM CO., 450 E. Ohio St., Chicago, Ill. Booths 701, 702; Fourth floor.



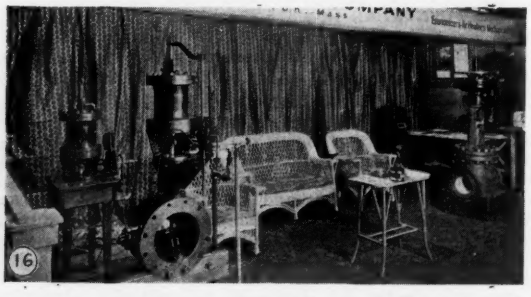
Working unit will be shown of the Dunham differential vacuum heating system including a boiler, series pump and radiators; also a D20 differential vacuum pump, Dunham condensation pump and receiver, both units under operation. Also will be a display of thermostatic radiator traps, float and thermostatic traps, return traps, air eliminators, packless, radiator valves, all in section form to show interior construction.

DURABLA MFG. CO., 114 Liberty St., New York, N. Y. Booth 236; Second floor.

Durable products in the complete line will be displayed. These will include metal pump valve units, asbestos fibre sheet packing, cut gaskets, semi-metalilc rod packing, high-pressure valve discs, gage glasses and gage glass washers. The display of metal pump valve units will be an especial feature.

DURAMETALLIC CORP., 806 Cobb Ave., Kalamazoo, Mich. Booth 749; Fourth floor.

Metallic packing in spiral form, die molded rings, wedge, tapered ring assemblies and plastic semi-metallic packing.



EASTERN STEAM SPECIALTY CO., INC., 242 LaFayette St., New York, N. Y. Booth 440; Third floor.

Apparatus will be shown of the Instant Water Heater Co. of Chicago and N. J. L. Flow Indicator of Los Angeles. Demonstration will be made of the operation of the Instant water heater and the action of the flow meter for vertical or horizontal lines and with nearby or remote indication.

ECONOMY PUMPING MACHINERY CO., 3431 W. 48th Pl., Chicago, Ill. Booth 471; Third floor.

Pumping machinery will be the feature of this display, in which will be included double-suction, horizontal, split-case centrifugal pumps of improved design in capacities from 50 to 3000 g.p.m., heavy duty multi-stage pumps with horizontal split case, one-piece bronze diaphragms, volute design in every stage and hydraulic balance at the outboard end; automatic condensation pumps and receivers, a unit being shown for 5000 sq. ft. capacity against 10 lb. pressure; centrifugal vacuum pumps of 16,000 sq. ft. capacity with horizontal

split case and bronze fittings; caisson pump with capacity of 300 g.p.m. against 120 ft. head.

EDGE MOOR IRON CO., Edge Moore, Del. Booths 288, 289, 290; Second floor.

Longitudinal drum boilers, waste heat boilers, cross drum boilers, heating and single pass boilers with details of construction and photographs of installation. Test data will be available for the study of visitors.

THE EDWARD VALVE & MFG. CO., East Chicago, Ind. Booth 30; First floor.

Newer members of the company's forged steel line will be found in this space, including flanged end, flanged bonnet, globe valves, 2 in. and smaller size for pressures up to 900 lb. Other features of interest will be larger valves illustrating the high-pressure line of cast steel and Ferac equipment.

ELLIOTT CO., Jeannette, Pa. Booths 271, 272, 273; Second floor.

This exhibit will feature a new turbine-driven centrifugal blower, single inlet, single stage, overhung type with cast-iron casing for simplicity and quiet operation. The impeller is of aluminum alloy, giving light weight and low stresses in the blades even at high speeds. The rest of the line of Elliott products covering steam turbines, engines, motors, condensers, ejectors, deaerators, feed-water heaters, strainers, separators and valves will be shown in photographs and enlargements.

LEWIS M. ELLISON, 214 W. Kinzie St., Chicago, Ill. Booth 44-B; First floor.

Main features of this exhibit will be Ellison draft gages and steam calorimeters, a special display being of the straight-line movement draft gages, pointer gages and for the steam calorimeter, adiabatic construction of within 2 deg. of theoretical temperature.

CHARLES ENGELHARD, INC., 30 Third St., New York, N. Y. Booth 675; Fourth floor.

Measuring and recording instruments for temperatures and for CO_2 in single and multiple form of both switchboard and portable type.

THE ENGINEER CO., 17 Battery Pl., New York, N. Y. Booth 18; First floor.

At this exhibition will be found Enco products, including a hydraulic system of combustion control, electric steam pressure regulator, electric damper regulator operating from furnace pressure, combined oil and gas burner, model of the Enco baffle of horizontal boilers, model of Enco cross baffles for vertical boilers, the latter planned to show two systems of baffling, one adapted to the ordinary furnace and one a combination of cross baffles with the back arch system for chain grate stokers.

ERIE CITY IRON WORKS, Erie, Pa. Booths 221, 222; Second floor.

This company will exhibit its three-drum, inclined water-tube boiler with integral economizer and Seymour basket-type water-cooled furnace. Another feature will be the Unitype pulverizer for pulverizing and feeding coal to individual boilers, while a third exhibit will show, concretely and in detail, construction of the company's Seymour furnace.

ERNST & CO., Newark, N. J. Booth 76; First floor.

Gage glass valves, safety gage glasses, water columns with inclined gage glass and red water reading.

EVERLASTING VALVE CO., 1 Exchange Pl., Jersey City, N. J. Booths 100, 101; First floor.

Everlasting Companion blowoff angle valve, screw-actuated for pressures up to 600 lb.; Everlasting blowoff valve with new conical disc spring, allowing complete compression without coils touching, for pressures to 250 lb. in ¼-in. to 6-in. sizes; special blowoff valves for 500 lb. in sizes, 1½, 2 and 2½ in. for boilers, economizers and water walls, having eccentric rack and pinion control for great power at starting or closing with short wrench movement; duplex blowoff unit with one disc valve and one Companion angle valve for 500 lb. pressure; tandem model X, with two valves, under one control in 2-in. and 2½-in. sizes; these will be features to be shown and demonstrated in this exhibit.

EX-CELL-O TOOL & MFG. CO., 1469 E. Grand Blvd., Detroit, Mich. Booth 664; Fourth floor.

Equipment as made for the Diesel engine trade will be shown, featuring precision parts, such as the fuel injection pump, fuel injection spray nozzle; also the company's standard line of drill jig bushings and internal grinder spindles.

THE FAFNIR BEARING CO., New Britain, Conn. Booth 246.

Ball-bearing transmission equipment, including hanger boxes, pillow blocks, blower boxes and loose pulleys, as well as a complete line of standard ball bearings with single row radial, double row radial, thrust and magneto type of construction will be shown. A main feature will be a table with all shafting mounted on ball bearings driven by a very small amount of power to demonstrate the frictionless operation of such bearings. Units will be shown with cut-away sections to make clear the construction.

FAIRBANKS, MORSE & CO., 900 S. Wabash Ave., Chicago, Ill. Booths 326 to 331; Second floor.

This company will exhibit a Diesel engine generating set, a sectionalized type H squirrel cage motor "running on a little air," a new enclosed self-ventilated type motor sectionalized to show construction and various other alternating and direct-current motors. Pumps will be shown, including the centrifugal ball bearing pump for high heads and others of centrifugal and power-driven types.

THE FALK CORP., Milwaukee, Wis. Booths 338, 339; Second floor.

Products here exhibited will be the company's herringbone gears and herringbone gear speed reducers, also the Falk flexible couplings. The main feature of this exhibit will be a motor-driven pump connected to a flexible coupling so that the motor moves at right angles with the shaft to demonstrate the ability of the coupling to stand misalinement and its freedom of end float.

FEDERAL GAUGE CO., 25 Church St., New York, N. Y. Booths 535, 544; Third floor.

Gauges for pressure and vacuum of indicating and recording type, also Mercoid switches having motor control actuated by changes of temperature and pressure, by vacuum or by position of a float.

THE FISHER GOVERNOR CO., INC., Marshalltown, Ia. Booth 35; First floor.

Display will be made of a full line of power plant specialties, manufactured by this company, a particular feature being its remote type of liquid level controller. Included will be pump governors, pressure regulators, sediment strainers, traps, reducing valves, relief valves, compound feeders and float valves.

FLEXIBLE STEEL LACING CO., 4607 Lexington St., Chicago, Ill. Booth 547; Third floor.

Alligator steel belt lacing, Flexco H. D. belt fasteners and Flexco-Lok guards for electric lamps will make up the exhibit in this space. Demonstration will be made of the method of applying the lacing and fasteners and of the use of the lamp guards.

FLYNN & EMRICH CO., Corner Holliday and Saratoga Sts., Baltimore, Md. Booth 46; First floor.

Working of the company's three-section Huber mechanical stokers will be shown by operation of a complete outfit in this space, showing drying and partial coking of the coal, method of feeding to the fire box, working backward along the grate and breaking up of the fuel bed.

FOOTE BROS. GEAR & MACHINE CO., 215 N. Curtis St., Chicago, Ill. Booth 550; Third floor.

Demonstration will be made of the company's lines of spur, worm and herringbone reduction units, including the following exhibits; a display panel of assorted gears, vertical worm gear reducer with 60 to 1 ratio and horizontal reducers with 40 to 1 and 60 to 1 ratios; spur gear reducers with 5.57 to 1 and 15 to 1 ratios; herringbone units with ratios of 10 to 1 and 17.8 to 1; Hygrade reducers of vertical and double worm type; combination unit, consisting of spur gear and added reducer giving total ratio of 1500 to 1; rubber cushion coupling and electric appliance combination unit with a.c. motor.

FOSTER ENGINEERING CO., 109 Monroe St., Newark, N. J. Booth 84; First floor.

Complete line of the Foster automatic valves will be exhibited, including some 30 automatic valves; also the Foster sight flow box in operation and complete sectional models of the Foster flexible ball joints. As a particular feature will be found drop forged cast-steel chrome constructions for high boiler pressures and temperatures, one important exhibit being a 6-in. angle, all chrome Foster non-return stop valve. Other valves of importance will be the G2S pressure reducing regulator and several different types of pump governors.

FOSTER WHEELER CORP., 165 Broadway, New York, N. Y. Booths 20, 64; First floor.

Exhibits shown will be a large Aero unit coal pulverizer, ready for operation; full size sections of Foster sectional air heater and of Foster economizer construction; Foster tubular oil still elements; full size sections of Foster superheaters of various types and for different services; Foster water-cooled furnace surface and Foster water back. Drawings and photographs will also be shown of Wheeler condensers,

pumps, cooling towers, evaporators and feed-water heaters. Wheeler steam-jet vacuum pump and special exhibit of Crescent brand brass and copper tubes and piping will be displayed.

THE FOXBORO CO., INC., Foxboro, Mass. Booth 62; First floor.

This company will show its regular line of improved indicating and recording thermometers and pressure gages; also draft gages, indicating and recording boiler level gages, multiple-pen recorders, tachometers, flue gas recorders and standard power plant instruments, with the various improvements and new designs which have been perfected during the past year.

THE FOUNDATION CO., 120 Liberty St., New York, N. Y. Booths 296, 297; Second floor.

Large photographs will be shown of steam and hydro-electric power plants which have been constructed by the company and detailed information will be available in regard to them and the company's methods of construction.

O. E. FRANK HEATER & ENGINEERING CO., 20 Milburn St., Buffalo, N. Y. Booth 657; Fourth floor.

Split shell, solid shell and U-tube storage heaters for feed water, domestic service, bleeder turbine use. Hot-water heating systems, oil heaters, air coolers, surface and vapor condensers and equipment for oil refineries.

FREDERICK IRON & STEEL CO., Frederick, Md. Booths 405, 406; Third floor.

Revolving roll separators for grading of coal, coke, limestone and materials of similar structure, also Frederick centrifugal pumps will be main features in this space. Complete miniature tipple with separator and loading booms will show actual operations in separation and sizing of coal from mine to cars. Mounted on a base plate and driven by a motor, a single-suction centrifugal pump will show through windows the path of water as it leaves the impeller. Another feature will be a 2-in., 3-stage pump for high-pressure or boiler feed service.

FULLER LEHIGH CO., Fullerton, Pa. Booth 54; First floor.

Features to be found in this booth will be coal pulverizing apparatus and equipment for feeding pulverized coal to

furnaces, section of the Bailey water-cooled furnace wall and the Fuller-Kinyon pump for transporting pulverized fuel. Models of the horizontal Calumet pulverized coal burner and Randolph vertical waste heat dryer will also be shown with details of the various apparatus.

FULTON-SYLPHON CO., Knoxville, Tenn. Booths 252, 253; Second floor.

Apparatus for the regulation of temperature and pressure and its application for special uses.

FURNACE ENGINEERING CO., INC., 5 Beekman St., New York, N. Y. Booth 41; First floor.

Simplex unit pulverizer with revolving hammers in capacities from 1500 to 15,000 lb. of coal an hour.

G & G ATLAS SYSTEMS, INC., 537 W. Broadway, New York, N. Y. Booths 86, 87, 88; First floor.

Pneumatic dispatch tubes, as installed for stores, banks and office buildings will be shown, with particular attention to the G & G Atlas power saving control valve for permitting a pilot flow of air when the line is not in use.

WM. GANSCHOW & CO., 1009 W. Washington Blvd., Chicago, Ill. Booth 750; Fourth floor.

Spur and worm gear type speed reducers for direct or right angle drives in horizontal or vertical form; also cut gears of worm spur, bevel and mitre type.

GARDEN CITY FAN CO., 332 S. Michigan Ave., Chicago, Ill. Booth 685; Fourth floor.

Multiblade type ventilating fan, motor-driven by means of tentacular belt on short centers, propeller type exhaust fan, positive pressure blower, slow speed improved type exhauster for collecting and conveying materials, and a Cyclo-Fin unit heater will be shown here.

THE GARLOCK PACKING CO., Palmyra, N. Y. Booths 545, 546; Third floor.

Decoration of this booth will be designed to carry out the company's colors, maroon, gold and black, the background being of maroon silk velour with black valances and the floor covered with rugs in the company's colors, having "Garlock" in gold in the center. The company will exhibit its Quality Controlled mechanical packings and show a mechanical working model of Garlock oil return metal packing and air and compressor packing, also a battery of condenser tubes showing actual application of condenser tube packing and the use of cord plugs for cleaning condenser tubes.

GENERAL ELECTRIC CO., Schenectady, N. Y. Booths 4, 5; First floor.

Motors and motor control, centrifugal air compressor, turbine battery charging equipment, fan-cooled motors.

GENERAL REFRACTORIES CO., 117 S. 16th St., Philadelphia, Pa. Booths 344, 345; Second floor.

Display will be made of the uniform brick made by the General Refractories Company's sized process, including hand-made brick, Biasbrix, Grefco chrome high temperature cement, samples of Arcofrax high alumina brick and other of the company's refractories.

GILLIS & GEOGHEGAN, 537 W. Broadway, New York, N. Y. Booths 86, 87, 88; First floor.

Particular attention will be given in this exhibit to safety devices which afford protection to operator and pedestrians when ashes are being removed and when doors are opened for ventilation of the boiler room. Included in the exhibit will be ash removal equipment, in both hand and electrically operated models, as installed by this company.

GIRTANNER ENGINEERING CORP., 122 Greenwich St., New York, N. Y. Booth 206; second floor.

Standard line of steam, jet, vacuum and hydraulic pipe line conveyors with a model of steam jet ash conveyor system in operation. Also hydraulic, steam, vacuum and water sluicing ash and soot conveyor systems duplicating actual plant conditions, ash pit and furnace doors.

GOETZE GASKET & PACKING CO., 50 Church St., New York, N. Y. Booth 252; Second floor.

Corrugated metal gaskets with asbestos filled grooves, also similar gaskets of monel metal, steel or lead; boiler gaskets for man holes, hand holes and tube caps, sheet packing, cylinder gaskets of metal filled with asbestos and valve gaskets or discs.

HENRY A. GOLWYNNE, INC., 26 Cortlandt St., New York, N. Y. Booths 429, 430; Third floor.

This company, representing also the Ohio Valley Clay Co. and Mullite Refractories Co. will exhibit super refractories in the form of Shamva Mullite brick in straight, standard and special shapes, also electric furnace roofs in single pieces and segments and special material, such as crucibles, electric porcelain insulators and needles.

JAMES T. GORDON Co., 270 E. Fourth St., Columbus, Ohio. Booth 92; First floor.

Water and oil strainers, worm gear and reduction gear unit, also the Nicholson steam specialties.

A. P. GREEN FIRE BRICK Co., Mexico, Mo. Booth 202; Second floor.

Refractory products and super plastic material for high temperature work; air setting cement; fire clay refractories and special shapes of brick.

GREEN FUEL ECONOMIZER Co., Beacon, Matteawan, N. Y. Booths 648, 649, 658, 659; Fourth floor.

Economizers, air preheaters, steel blade fans, radial blower fans and mechanical draft installations.

GRINNELL Co., Providence, R. I. Booths 530, 531, 548, 549; Third floor.

The new Grinnell Triple line of equipment for super power will be shown, giving choice of any type of joint for varying conditions with maximum strength. Included in the exhibit will be offset bends, featuring reinforced laps with plain, tongue and groove, and sargol facings; with high-hub, rolled-steel lap joint flanges. Also will be shown welded steel brackets with adjustable pipe stands, pipe covering protection saddles and anchor chairs to support bends, with illustration of the method of use in actual installations. Lap joint sections of pipe will be shown in various sizes, including plain, serrated, sargol, tongue and groove processes for reinforced laps. Also in the exhibit will be found test pieces showing the security of coupling welds, butt welds and lap joints with flanges; a line of adjustable pipe hangers and supports and of cast iron fittings.

GRISCOM-RUSSELL Co., 285 Madison Ave., New York, N. Y. Booth 49; First floor.

Evaporators and heat exchange apparatus will be the features in this exhibit. Included will be Reilly evaporators and water heaters, U-Fin generator air cooler, Stratton steam and air separators and the Griscom-Russell Bentube evaporator. Other specialties shown will be the G-R water heaters, multiwhirl coolers and expansion joints.

THE HAGAN CORP., Bowman Bldg., Pittsburgh, Pa. Booth 21; First floor.

Several new Hagan products will be found awaiting engineers interested in combustion control, steam purification, boiler water conditioning for prevention of scale and corrosion, desuperheating and pressure control. Electrically operated control apparatus will be exhibited for the first time as developed for the gas industry and industrial furnace use, designed especially for sensitiveness, incremental movement, freedom from hunting and trouble. Working exhibit will be made of the Hagan centralized boiler control system with simplified elements. Hagan steam purifiers will be displayed with records of year's achievement, and chemical engineers will be in attendance to discuss the Hall system of boiler water conditioning.

HARDINGE Co., INC., York, Pa. Booth M, 26; First floor.

Model will be exhibited of the Ruggles-Coles dryer and the Hardinge clarifier and filter. A scene-in-action picture will be shown to illustrate the operation of the Hardinge conical mill and air clarifier. In addition a small working model of a new unit coal pulverizer will be demonstrated, this being a special feature of the exhibit.

A. J. HEMPHILL Co., INC., 233 Center St., New York, N. Y. Booth 611; Fourth floor.

Casters of the Bond Foundry & Machine Co. including truck casters designed for light and for heavy loads, with all types of wheels and with various designs of ball races, including a new addition, the Bond Ajax steel caster. Included in the exhibit will be power transmitting machinery and roller bearings for line shaft and industrial uses.

HENDRICK MANUFACTURING Co., Carbondale, Pa. Booth 431; Third floor.

A special feature of this exhibit will be a stairway and walkway made of Mitco interlocked steel grating and Mitco Shur-Site stair treads. Included also in the exhibit will be samples of these steel grating and stair treads, perforated metal screens and elevator buckets showing detailed construction.

PAUL F. HERMANN, Keenan Bldg., Pittsburgh, Pa. Booths 737, 738; Fourth floor.

Stationary and operating industrial models for advertising purposes, showing power plant and industrial machinery.

E. VERNON HILL Co., 121 N. Clark St., Chicago, Ill. Booth 212; Second floor.

Exhibits here shown will be gages, synthetic air charts, psychrometric charts, air testing instruments, wet and dry bulb instruments, and a publication called The Aerologist for all those interested in air testing.

HOFFMAN SPECIALTY Co., Waterbury, Conn. Booths 633, 634; Fourth floor.

Air valves and heat control specialties, also several traps for different operating conditions in actual working demonstration.

M. A. HOFFT Co., 814 W. Washington Ave., Indianapolis, Ind. Booth 323; Second floor.

Here will be shown a half stoker and a half arch with screw conveyor and paddle wheel feeder as used for feeding refuse into the furnace. The equipment will be in operation much the same as in an actual plant and will be the equivalent of that used in the G. I. Sellers plant.

HOMESTEAD VALVE MFG. Co., Homestead, Pa. Booths 443, 444; Fourth floor.

Hovalco-Homestead combination blowoff valves will be shown for 250 lb. pressure, also cast steel blowoff combination valves for higher pressures. The entire Homestead quarter-turn line for various services in industrial and power plants will be displayed, the special developments during the year being in adding larger sizes to the line. These larger valves are, in many cases, operated by a gear mechanism and all are of lubricated type with Alemite system of lubrication. Another valve perfected during the past year is the remote control B & O protected seat hydraulic operated valve for use in blooming mills on hydraulic presses and other similar operations, where larger operating valves from 2 in. up are necessary.

THE PAUL B. HUYETTE Co., 5 S. 18th St., Philadelphia, Pa. Booths 81, 82; First floor.

This exhibit will concentrate for its main features on the Hays line of combustion apparatus, Cochrane flow meters, PBH boiler room specialties and boiler panel. Working cross cut section model will be shown of the Hays CO_2 recorder, gage board with full display of the entire Hays line of draft gages, demonstrating model of Cochrane flow meters, Ajacks damper regulator, section models of Reliance safety water columns as equipped with PBH water gages, gage adaptors, gage glass protectors, gage cocks and Libby gage glasses.

HYATT ROLLER BEARING Co., Harrison, N. J. Booths 497, 498; Third floor.

For the central attraction of this booth a novel feature has been provided which will be kept as a surprise for visitors. Included in the exhibit will be a complete line of roller bearings for every phase of industry, the new roller bearing journal box for steam railroad cars being one of the types. Another will be the split box for line shaft roller bearings.

ILG ELECTRIC VENTILATING Co., 324 W. Monroe St., Chicago, Ill. Booth 278; Second floor.

Multi-blade blower, direct motor driven by variable speed motor, also heating unit of electric type with heating coils and multiple blower fan. Ilgair portable floor fan for cooling hot spots in manufacturing plants.

ILLINOIS ENGINEERING Co., 21st and Racine Ave., Chicago, Ill. Booth 232; Second floor.

Featured in this exhibit will be a glass model of a ¾-in. Eclipse steam trap operating under actual working conditions to demonstrate the quick opening and closing of the valve and the high lift of the valve when open. Included in the display will be a complete line of the company's steam and vapor specialties.

IMPERIAL COAL CORP., 342 Madison Ave., New York, N. Y. Booth 729; Fourth floor.

Data will be in evidence here in regard to the evaporations and efficiencies obtained in actual tests, using the various kinds of coal which the company supplies. Types, veins and classifications of coal for power plants, steamships, locomotives and domestic use will be shown.

INGERSOLL-RAND Co., 11 Broadway, New York, N. Y. Booths 554-557; Third floor.

Cameron pumps and special features of Ingersoll-Rand surface condensers. Multistage boiler feed pump will be shown for pressures up to 1500 lb. with improved thrust device and Kingsbury thrust bearings.

INSTANT WATER HEATING Co., 332 S. Michigan Ave., Chicago, Ill. Booth 440; Third floor.

Heaters for instantaneous supply of water for house service in power plants.

INSULATING PRODUCTS CORP., 280 Madison Ave., New York, N. Y. Booth 437; Third floor.

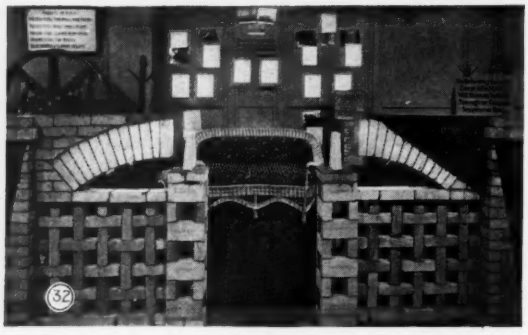
Insulating materials for steam systems and special methods of application.

INTERNATIONAL COMBUSTION ENGINEERING CORP., 200 Madison Ave., New York, N. Y. Booths 23, 24, 25-A; First floor.

Pulverized fuel systems of both central and unit type; Lopulco system for burning pulverized fuel and two-screw feeder; Raymond pulverizing mill; construction of water cooled furnace wall and self-supporting wall; full-size elements of C-E air heater. Combustion steam generator shown as a model and with action indicated by motion picture, also details of construction.

INTERNATIONAL NICKEL CO., 67 Wall St., New York, N. Y. Booth 9; First floor.

Monel metal and pure nickel will be shown in commercial forms, including rods, sheets, tubes, wire, forgings and castings. Exemplifying various uses of Monel metal in vital parts of power plant equipment, will be displayed a large assortment of manufactured parts loaned for this purpose, each part being labeled for the information of visitors with the name and booth number of the maker and the use of the part.



IRON FIREMAN AUTOMATIC STOKER CORP., 535 Fifth Ave., New York, N. Y. Booths 682, 683; Fourth floor.

Automatic furnace for heating plants in capacities up to 200 hp. designed especially to overcome difficulties in handling low pressure plants.

IRVING IRON WORKS CO., Long Island City, New York. Booths 438, 439; Third floor.

Irving subway open steel ventilating flooring and the company's streamline modification of the same product will be shown, also the Vizabledg Safsteps. Another feature of the exhibit will be the new Irving Unified system of reinforcement and surface armor for concrete bridge floors.

D. O. JAMES MFG. CO., 1114 W. Monroe St., Chicago, Ill. Booth 752; Fourth floor.

Speed reducers of direct and angle drive herringbone gear type also cut gears, rawhide and bakelite pinions and flexible and universal couplings. Direct, angle and vertical drive spur gear speed reducers, Heavy-duty worm gear speed reducers.

JENKINS BROS., 80 White St., New York, N. Y. Booth 90; First floor.

Medium and extra heavy valves for control of water, air, steam and gases will be shown here; also a full line of mechanical rubber goods for power plant uses and, in addition, a full line of Moncrieff gage glasses. A feature of the exhibit will be a rapid action valve for control of water, demonstrated in operation.

JOHNS-MANVILLE, INC., 300 Madison Ave., New York, N. Y. Booth 314, 315; Second floor.

Processes by which raw asbestos is converted into the products made by this company, such as packings, power specialties, insulation, roofings, electrical material will be a major feature of the exhibit. Types of insulation will be exhibited and demonstration made of the savings in heat energy by the use of these materials.

JOHNSON SERVICE CO., Milwaukee, Wis. Booths 403, 404; Third floor.

Temperature control systems for steam and hot water heating with details of apparatus and demonstration of method of action.

W. A. JONES FOUNDRY & MACHINE CO., 4401 W. Roosevelt Rd., Chicago, Ill. Booth 493; Third floor.

This company's exhibit will consist primarily of enclosed spur and worm gear speed reducers, including standard double type spur gear reducers, also a new type of heavy duty worm gear reducers in two sizes, shown for the first time.

JUSTUS STEAM TRAP CO., Napanoch, N. Y. Booth 715; Fourth floor.

Justus steam traps and thermostats shown in detail and demonstrated in action.

E. F. KEATING PIPE BENDING & SUPPLY CO., Hartford, Conn. Booths 229, 230.

Samples of reinforced square corner Van Stone joints will be shown made from both genuine wrought iron pipe and steel pipe, for pressures up to 600 lb. and temperatures up to 750 deg. In addition, large pipe bends will be shown, also welded flanged headers for power plant work and coils made from brass, copper, steel and genuine wrought iron pipe, suitable for refrigerating, air conditioning, dye house, and other industrial uses.

E. KEELER CO., Williamsport, Pa. Booth 211; Second floor.

Glass boiler models will be shown illustrating the internal working of the company's boilers when in operation. These models are intended to give engineers accurate information and are not of size to give a spectacular demonstration. In addition to the models a full size section of the header of water tube boilers will be displayed, showing the construction and smaller parts will also be on exhibit.

KEITH DUNHAM CO., 110 S. Dearborn St., Chicago, Ill. Booths 643, 644, 645; Fourth floor.

Complete plant for liquefying air and separating it into its main elements to secure oxygen will be shown in operation in this exhibit. Pipe bends so made that outer and inner walls remain of the same thickness, even for a bend on radius equal to pipe diameter, will also be shown.

THE M. W. KELLOGG CO., 7 Dey St., New York, N. Y. Booth 16; First floor.

Samples will be shown of high-pressure steam piping, with special features of forge welded nozzles, flanges, Dean Swingate and parallel slide gate valves.

KEYSTONE LUBRICATING CO., 21st Clearfield and Lippincott Sts., Philadelphia, Pa. Booth 3; First floor.

Keystone safety lubricator will be exhibited for manual operation, for spring automatic operation and for pneumatic operation. Operating display will show the various systems of pressure generation; also the Keystone pressure regulating valves and other accessories. Liquid greases for electric motor bearings, high temperature grease for bearings operating under abnormal temperatures and other lubricants for special industrial conditions will be displayed.

KEYSTONE REFRACTORIES CO., 120 Liberty St., New York, N. Y. Booth 11; First floor.

Featured in this exhibit will be Keystone products, including Dura-Stix, Steel Veneer, Crundum sand and Plastabrix refractories, also the Keystone sprayer for application of refractories in liquid form.

KIELEY & MUELLER, INC., 34 W. 13th St., New York, N. Y. Booths 533, 534; Third floor.

New designs of steam specialties will be shown here with the features which have been incorporated during the past year. These will include pressure reducing valves, back pressure valves, steam traps and other of the company's steam specialties.

KILSOOT CHEMICAL CO., INC., 530 W. 58th St., New York, N. Y. Booth 721; Fourth floor.

This company will display different packages of its product, which is designed for use in furnaces to remove soot deposits in tubes, flues, stacks and chimneys and to prevent further accumulation.

KING REFRACTORIES CO., INC., 1709 Niagara St., Buffalo, N. Y. Booth 95; First floor.

Boiler baffling and high temperature cement, also special Flame brand cement to meet various high temperature requirements in furnace operation.

KISSICK-FENNO CO., INC., 15 Park Pl., New York, N. Y. Booth 19; First floor.

In the space of this company will be found products of the Vulcan Soot Cleaner Co. and the Northern Equipment Co. Vulcan products exhibited will be the soot cleaner with self contained valve operating head and ratchet operating head, also Crodon and super-Crodon blower elements of chrome alloy to protect against corrosion.

Northern Equipment Company's apparatus will include the Copes boiler feed water regulator and pump governor with a moving display of the regulator in action and its automatic control of feed water input.

WM. F. KLEMP CO., 6624 S. Malvina Ave., Chicago, Ill. Booth 757; Fourth floor.

Diamond gratings for floors, stairways and overhead runways.

KLINGERIT, INC., 16 Hudson St., New York, N. Y. Booth 317; Second floor.

Klingerit sheet packing and gaskets of asbestos, discs for Jenkins valves, Klinger's two-color stuffingbox packing and rings, piston valves and reflex water gages will be included in the exhibit. The main feature will be the two-color stuffingbox rings.

THE KORFUND CO., INC., 235 E. 42nd St., New York, N. Y. Booth 627; Fourth floor.

In actual operation will be shown a steam engine of the Troy Engine & Machine Co. isolated by Korfund vibrodampers against the transmission of vibration and noise. In addition, there will be exhibited blueprints, photographs and descriptive material showing how this device is used for isolation of all kinds of power plant machinery against transmission of vibration.

LADD WATER TUBE BOILER CO., First National Bank Bldg., Pittsburgh, Pa. Booth 91; First floor.

Construction of details will be shown, also drawings and photographs of the various types of boiler, such as heavy duty high arch and multi-drum, and the various arrangements of superheaters.

LAMONT CORP., 200 Fifth Ave., New York, N. Y. Booth 619; Fourth floor.

Steam generators and duplex steam sealed valves. Outstanding feature of the steam generator is film evaporation with extremely rapid heat transfer.

LANDIS MACHINE CO., Waynesboro, Pa. Booth 708; Fourth floor.

Pipe threading and cutting machinery with stationary die head.

LEAD LINED IRON PIPE CO., Wakefield, Mass. Booth 86; First floor.

Galvanized and amalgamated lead lined iron pipe and fittings for boiler feed work. Acid resisting lead lined pipe, also tin lined iron pipe and fittings.

THE LEAVITT MACHINE CO., Orange, Mass. Booth 432; Third floor.

In a piping arrangement having 6-in. globe and gate valves installed, the company's globe valve reseating machine will be shown operating to reseat the valve, thus giving a practical demonstration of the action of these machines. In addition will be shown the complete line of Dexter valve reseating machines for globe valves, gate valves and pump valve seats.

THE LEEDS & NORTHRUP CO., 4901 Stenton Ave., Philadelphia, Pa. Booths 433, 434, 435.

Displayed here in actual operation will be the L. & N. metered combustion control system mounted on boilers simulating those in actual practice. The system will demonstrate the metered rate of flow of air as against fuel independent of the calibration of dampers, valves or rheostats. Also rapid regulative action for large degrees of unbalance and small corrections as balance is approached. Other features will be the L. & N. CO_2 meters, electrically operated, flue gas temperature recorder, steam and feed water temperature recorder, condenser leakage recorder, generator and transformer temperature recorder and frequency meter. All apparatus will be shown in actual operation.

LESLIE CO., Lyndhurst, N. J. Booth 505; Third floor.

Special presentation will be made of new and improved design of automatic regulators for steam, air, gas, oil and water. The new and special features will be demonstrated by sections showing all working parts. A new design of automatic pump regulator will be included, also reducing and relief valves, pressure, pump and excess-pressure regulators, and self-cleaning strainers.

LIBERTY ELECTRIC CORP., Stamford, Conn. Booth 422; Third floor.

Liberty valve operator for local and remote control by push button, demonstrated in actual operation showing the use of the safety clutch which will slip when the straining point of the valve is reached and prevent breaking of valve stems.

THE LINCOLN ELECTRIC CO., Coit Rd. and Kirby Ave., Cleveland, Ohio. Booths 766, 767; Fourth floor.

Complete exhibit will be made of the Linc-Weld motor and the Stable-Arc welder. In the welder exhibit will be found the latest portable type on steel truck with the apparatus in actual operation of welding; also a miniature booth with protective glass windows will be a feature so that spectators can watch the Arc in operation and note the method and speed of the welding. Of interest will be the Linc-Weld motor operating totally submerged in a glass tank filled with water; also details of construction of the motor and of the Lincoln two-speed elevator motor will be shown.

LINDE AIR PRODUCTS CO., 30 E. 42nd St., New York, N. Y. Booths 265, 266; Second floor.

This booth will feature applications of oxy-acetylene welding to power plant construction, specializing on the joining of steel pipe for high pressure steam, gas, water and oil service. Oxy-acetylene welding will be demonstrated, also the use of cutting equipment and the gases for the work.

LINK-BELT CO., 910 S. Michigan Ave., Chicago, Ill. Booths 677, 678, 679; Fourth floor.

Products shown will be the Sykes herringbone speed reducer, vibrating screen, new Link-Belt anti-friction belt conveyor idler, Caldwell speed reducer, Caldwell car spotter, Link-Belt silent chain and other drive chains. Illustrations of details and installations will also be given in regard to the Peck carrier, coal crushers, feeders, car dumper, locomotive crane, crawler crane, portable loaders, water intake screen, power hoe, skip hoist and other coal and ash handling equipment.

LOCKE REGULATOR CO., Salem, Mass. Booths 444, 445; Third floor.

New designs, differing radically from those shown in former years, will be found in this display of pressure reducing valves, damper regulators, automatic engine stop equipment, float control valves, safety shutoff valves, nonreturn valves, hydraulic regulators, balanced valves and exhaust relief valves. Besides the display, catalogs and circulars will be found, describing all the company's products.

E. G. LONG CO., 50 Church St., New York, N. Y. Booth 752; Fourth floor.

This company will exhibit the product of D. O. James Mfg. Co., including power transmission materials and belt appliances, chain drives and belting, elevating, conveying and power transmitting machinery.

THE LUNKENHEIMER CO., Cincinnati, Ohio. Booth 63; First floor.

Here will be found a representative array of the various valves of Lunkenheimer manufacture. These will include valves for high pressures of steel with monel mountings, electrically operated gate valves, large and small valves for extremely high pressures and a full line of smaller valves for all power plant purposes.

MCCLAVE-BROOKS CO., Scranton, Pa. Booths 561, 562, 563; Third floor.

Forced draft, chain grate stokers of new design for anthracite and bituminous coal, a complete dumping grate for anthracite, grates for bituminous coal and a hand-fired stoker for bituminous coal will be found in this space. All features will be shown by detail parts, by sections and blue prints, and operation of the stokers will be demonstrated.

MCLEOD & HENRY CO., Troy, N. Y. Booth 13; First floor.

Fire brick arches, blocks and high temperature cement

and methods of using these for building up boiler settings. McLeod & Henry full size flat suspended arches and Steel Mixture veneer wall brick for furnace linings.

MANISTEE IRON WORKS, Manistee, Mich. Booths 219, 220; Second floor.

Roturbo pump featuring 8-stage horizontally split pump, single stage voltage pump and the Roturbo impeller.

MANNING, MAXWELL & MOORE, INC., 100 E. 42nd St., New York, N. Y. Booth 60; First floor.

Steam specialties including Ashcroft gages, Consolidated safety valves for high pressure lines, Metropolitan injectors and Hancock valves in bronze, cast steel and forged steel material.

MANZEL BROS. Co., 309 Babcock St., Buffalo, N. Y. Booth 705; Fourth floor.

Built-in lubricators and sight feed oil pumps for all types of machinery, in single and double feed with ratchet or rotary drive.

MARION MACHINE, FOUNDRY & SUPPLY Co., Marion, Ind. Booth 210; Second floor.

Type AB Marion soot blower will be shown with balanced head and independently operated valve-at-head. Details of the welded venturi nozzles and high temperature elements of special alloy will also be shown and, in addition, the Marion Gulf Stream water heater, a device for furnishing hot water instantly wherever steam is available.

MARLIN-ROCKWELL CORP., Jamestown, N. Y. Booth 337; Second floor.

Gurney ball bearings in radial, thrust and duplex type, double and single row.

W. A. MARSHALL & Co., 17 Battery Pl., New York, N. Y. Booth 628; Fourth floor.

Featured in this exhibit will be a miniature trestle and coal pockets equipped to handle bituminous coal for domestic and steam purposes; also a display of Shallmar and Havmar coals.

MASON REGULATOR Co., Dorchester Center, Boston, Mass. Booths 223, 224; Second floor.

Pressure regulators, reducing valves, pump governors for pressure and speed control, hydraulic damper regulators, balanced and float valves, fan and stoker engine regulators and a full line of bronze and iron body valves for high pressures.

THE MAXIM SILENCER Co., 410 Asylum St., Hartford, Conn. Booth 654; Fourth floor.

Exhibit will be made of the Maxim silencer as applied to Diesel engines, air compressors, blowers, pumps and power plant equipment for eliminating the noise of exhaust discharge.

MERCON REGULATOR Co., 53 W. Jackson Blvd., Chicago, Ill. Booth 248; Second floor.

Mercon control equipment for regulation of pressure up to 900 lb. at temperature of 750 deg., also for water level control and the operation of boiler feed pumps.

MERRICK SCALE MFG. Co., Passaic, N. J. Booths 237-240; Second floor.

Merrick Conveyor Weightometer in operation, handling actual material; Mechanical Weighman, operating on weigh tanks; Addoweight, a totalizing dial scale attached to overhead track system to weigh buckets while in motion; Merrick-Hebden Weightoprint for weighing and recording weight of individual packages passing over a gravity conveyor.

MIDWEST PIPING & SUPPLY Co., St. Louis, Mo. Booth 268; Second floor.

Globack joints for 600, 900 and 1350 lb. pressure will be shown for the first time. These have spherical back face on the lap of the existing Sargol tongue and groove and male and female Van Stone joints. Flange contact surface is also spherical to provide thick metal at the lap area, stiff lap and uniform distribution of bolting pressure. Microphotographs will show the structure of metal resulting from hot working.

MIXING EQUIPMENT Co., INC., 229 E. 38th St., New York, N. Y. Booth 3-E; Third floor.

Models of electric portable mixers will be shown in large and small sizes for use in tanks, kettles, barrels and large bottles.

MODINE MFG. Co., Racine, Wis. Booth 635; Fourth floor.

Thermodine unit heaters with fan and motor assembly, also cabinet heaters and humidifiers with flattened copper tubes.

MOORE STEAM TURBINE CORP., Wellsville, N. Y. Booths 598, 599; Third floor.

New development in the steam turbine line will be illustrated by a single stage turbine with integral reduction gear. This is especially adapted for auxiliary drive where a low steam consumption is desired with inexpensive first cost. Another feature of the exhibit will be the pinion of a 1500-hp. three-bearing reduction gear, the turbine wheel of a 1000-kw. turbine and a feed unit consisting of turbine and boiler feed pump with pump governor.

MORSE CHAIN Co., Ithaca, N. Y. Booths 263, 264; Second floor.

Silent chain drives of various sizes in actual operation, demonstrating rocker joint construction and efficient action.

Enclosed drive demonstrating drip oiler. Spring sprocket for overloads. Morse rocker joint clock.

THE MOTO METER Co., INC., Long Island City, N. Y. Booths 256, 257; Second floor.

Motoco industrial thermometers will be shown, suitable for industrial application; also a line of small pressure gages. The use of both types of instruments will be demonstrated.

THOS. E. MURRAY, INC., 55 Duane St., New York, N. Y. Booth 301; Second floor.

Photographs and illustrations of plants designed and installed by this company, with special features which it has incorporated.

MURRAY CONDUIT SYSTEMS, 55 Duane St., New York, N. Y. Booth 300; Second floor.

Equipment illustrating the construction of Murray monolithic conduit will be shown, as employed for lighting, power, signal and control conduit lines in generating and substations. This construction is used for high tension underground transmission and distribution and for railway signal control. A special feature will be motion pictures illustrating the operation of equipment under field conditions; also full size samples of this conduit with photographs of representative installations in various parts of the country.

NASH ENGINEERING Co., S. Norwalk, Conn. Booth 66; First floor.

Vacuum and condensation pumps for removing gases, air and condensate from heating systems of Jennings-Hytor type, also circulating pumps for hot water condensing systems and sewage ejection.

NATIONAL Co., INC., Cambridge, Mass. Booth 76; First floor.

Water column illuminators for distant reading of water level.

NATIONAL TUBE Co., Frick Bldg., Pittsburgh, Pa. Booths 8-A, 8-B; First floor.

Shelby seamless tubing, National boiler tubes, National pipe, including welding scale-free pipe and Van Stone flanges.

NAUGATUCK MFG. Co., Naugatuck, Conn. Booth 481; Third floor.

Complete line of the company's seamless copper floats will be shown, as used for steam traps, water columns, governors, receivers and other uses. Seamless nickel floats will also be shown for high steam pressures and seamless copper open tank floats from 1 to 20 in. in diameter in both round and oblong types.

NEEMES FOUNDRY, INC., Troy, N. Y. Booth 93; First floor.

Superior dumping grates, improved shaking and dumping grates and hand operated stoker as built by this company. Display of details showing full construction and special features.

HERMAN NELSON CORP., Moline, Ill. Booths 608, 609; Fourth floor.

The Uni-vent for furnishing clean fresh air without draft.

W. H. NICHOLSON & Co., Wilkes-Barre, Pa. Booth 92; First floor.

In operation will be shown a piston-operated steam trap, the working model being operated by compressed air and having glass windows and sides to permit inspection of the operating cycles. Nicholson welded nickel steel float for high pressure superheat will also be shown.

NILES GEAR CO., 111 Broadway, New York, N. Y. Booths 457, 458; Third floor.

Maag gears in spur, herringbone, helical and spiral types, designed to avoid undercutting regardless of the number of teeth.

NORMA-HOFFMAN BEARINGS CORP., Stamford, Conn. Booths 279, 280; Second floor.

Samples will be shown of ball, roller and thrust bearings with representative mounting on reduction gears, motors and other plant equipment. Demonstration of the antifriction quality of bearings and the amount of creep in operation.

NORTHERN EQUIPMENT CO., Erie, Pa. Booth 19; First floor.

Moving display of Copes boiler feed water regulator in operation to demonstrate the automatic control of feed water input and the relation maintained between water level and boiler load. Exhibit of condensate drainage control system with pump governor, valve movement indicator and control valves.

R. D. NUTTALL CO., McCandlen Ave. and Harrison St., Pittsburgh, Pa. Booth 684; Fourth floor.

Speed reducers, flexible couplings and heat treated gearing will be exhibited. Particularly will be featured the new Nuttall series of standard speed reducers in single and double reduction. These are constructed with single helical gears, heat treated and hardened, Timken roller bearings, a three section case and positive system of splash lubrication.

OAKITE PRODUCTS, INC., 22 Thames St., New York, N. Y. Booths 734, 735; Fourth floor.

Charts, blueprints and literature illustrating the application of Oakite cleaning materials and methods in power plants will make up an educational exhibit in this space. Particular attention will be given to the processes of cleaning oil coolers, surface condensers and other equipment.

S. OBERMAYER CO., 2563 W. 18th St., Chicago, Ill. Booth 260; Second floor.

Refractory materials including high temperature furnace cements and asbestos materials for furnace linings; demonstration of application of plastic material for repairing furnace linings and results obtained from its use.

TINIUS OLSEN TESTING MACHINE CO., 500 N. 12th St., Philadelphia, Pa. Booth 318; Second floor.

Testing machines for hardness and ductility of materials for testing balance of moving parts and for automatic recording of the results of tests. Olsen-Lundgren dynamic balancing machines for indicating by centrifugal, electrical principles angle and amount of unbalance of rotors. Also balancing machine for wheels and tires. Universal testing machine with Olsen-Smith automatic recorder, making magnified stress—strain diagram within the elastic limit.

OTIS ELEVATOR CO., 260 11th Ave., New York, N. Y. Booth 57; First floor.

Commercial steel castings will be shown here, all made by the electric process. Various types as made in the company's Buffalo plant will be exhibited showing the possibilities of such castings and the uniformity in material which is secured.

OXWELD ACETYLENE CO., Charleston Ave. and Orton St., Long Island City, N. Y. Booth 530; Third floor.

Injector type welding and cutting equipment, acetylene generators and demonstration of the Oxweld process, for welding and cutting material.

PAYNE-DEAN CO., 402 Madison Ave., New York, N. Y. Booth 16; First floor.

The Dean system for valve control which can be operated from several stations, but is interlocked so that when one station is working, all others are locked out.

PEABODY ENGINEERING CORP., 110 E. 42nd St., New York, N. Y. Booth 47; First floor.

Peabody burners for powdered coal, fuel oil or gas firing, including the newest type of large capacity Toronto burner and the novel insulated-front burner will be exhibited. A further feature will be an automatic viscosity regulator to maintain burner efficiency regardless of varying physical characteristics of the oil through special automatic regulation of the heating unit in the oil feed line.

PEERLESS UNIT VENTILATION CO., Long Island City, N. Y. Booths 747, 748; Fourth floor.

Unit heaters of light weight in suspended or floor type units.

HENRY PELS & CO., 88 West St., New York, N. Y. Booths 499, 500; Third floor.

Machines for use as universal punch, splitting shear bar, angle and T cutter for fabrication and construction work.

PENNSYLVANIA CRUSHER CO., Liberty Trust Bldg., Philadelphia, Pa. Booths 286, 287; Second floor.

Working model of Bradford coal breaker and cleaner, also of Armorframe single roll crusher and specialized machinery for crushing.

PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa. Booths 522, 523; Third floor.

High pressure, six-stage boiler feed pump for pressures of 300 to 500 lb. with balanced thrust. Details to show construction of impeller, wearing ring, monel metal shaft sleeves and bushings, and carbon packing and high pressure steels.

THE PERMUTIT CO., 440 Fourth Ave., New York, N. Y. Booths 3, 28; First floor.

The principal and most interesting exhibit of the company will be a model of water softening and filtering equipment as used in industrial plants. This is made exactly to scale after the design of a large commercial unit to deliver 100,000 gal. a day and will be about 4 ft. long, all pipes and strainers in the water softening equipment being reproduced in miniature. Included also in the exhibit will be Ranarex instruments for recording CO_2, gas density, ammonia gas and similar values, these being found in Booth 28. The water softening exhibit will be in Booth 3.

PHILADELPHIA GEAR WORKS, Erie Ave. and G Sts., Philadelphia, Pa. Booth 10; First floor.

Gears and speed reducing units will be shown in this display.

PITTS & KITTS MFG. & SUPPLY CO., 91 Seventh Ave., New York, N. Y. Booth 451; Third floor.

Steam accessories, including traps, reducing valves, feed water regulators, damper regulators, high and low water alarms, water gages and gage cocks, high temperature cement and boiler wall covering.

PITTSBURGH PIPING & EQUIPMENT CO., 35th and Elizabeth St., Pittsburgh, Pa. Booths 420, 421; Third floor.

Pipe line construction with details of fittings and joints. Photographs of installations in power plants, also welded headers, pipe expansion bends, line welds and examples of special joints for high pressure work.

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO., 26th St. and A. V. R. R., Pittsburgh, Pa. Booth 4; First floor.

Valves and piping for high pressures and temperatures, the valves being of cast steel with monel mountings in hand and motor operated types. Atwood line welds, welded headers and other specialties. As a special feature will be shown a 14-in. cast steel non-return valve for 400 lb. working pressure.

PLIBRICO JOINTLESS FIREBRICK CO., 1800 Kingsbury St., Chicago, Ill. Booth 93; First floor.

This display will include a Plibrico wall showing the method of installation, an opened drum of Plibrico, showing the character of the material and a moving picture entitled Fighting Furnace Failures. Photographs and literature describing the method of using the product and installations which have been made will also be shown.

POOLE ENGINEERING & MACHINE CO., Woodberry St., Baltimore, Md. Booth 467; Third floor.

All metal flexible couplings with internal gears meshing with gears on the end of shaft hub. Herringbone speed

transformer with double herringbone gears running in oil or lubricated by splash system.

PORTER-CABLE MACHINE CO., Syracuse, N. Y. Booth 667; Fourth floor.

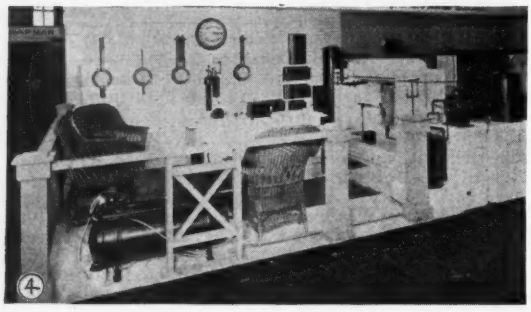
This company will exhibit the Take-About hand sander for finishing all types of wood work of curved or flat surfaces and for rubbing filler coat on large machine castings, or for polishing metal. Also the Kwicksaw, a small direct motor-driven hand saw for use in packing rooms and carpenter shops and the company's 10-in. belt sander and grinder; also a 15-in. disc sander, used for various types of grinding and smoothing in wood and metal working shops.

THE WM. POWELL CO., 2521 Spring Grove Ave., Cincinnati, O. Booths 494, 495; Third floor.

This space will have an educational exhibit showing the complete processing from foundry to finished product for bronze, iron and steel valves. In addition a special large lot of steel valves, hand and electrically operated, will be shown for pressures from 150 to 900 lb. Also will be found a full line of bronze, iron and steel valves in globe, angle, gate, check and safety type. Oilers, lubricators, grease cups, oil and water gages and whistles will form an attractive background.

POWERS REGULATOR CO., 2769 Greenview Ave., Chicago, Ill. Booth 640; Fourth floor.

Systems of temperature and humidity control for factories and offices; thermostatic regulators for controlling hot and cold water mixtures; shower mixtures; steam traps, reducing valves and dial indicating thermometers.



PRAT-DANIEL CORP., 101 Park Ave., New York, N. Y. Booth 656; Fourth floor.

This corporation will exhibit Thermix products including the assembled air heater and adjustable soot blower for plate type heaters; also Type I streamline stack for high drafts with induced draft fan handling all of the gas and Type III stack for low drafts with improved fan and ejector system. Photographs of illustrations and new catalogs will be included in the exhibit.

PREFERRED UTILITIES CO., INC., 33 W. 60th St., New York, N. Y. Booths 304, 305; Second floor.

Ray turbine fuel oil burner, also electrically driven fuel oil burner with steam actuated oil and air control.

PYRAMID IRON PRODUCTS CORP., 136 Liberty St., New York, N. Y. Booths 306, 307; Second floor.

Grates and details of grate settings.

PYROMETER INSTRUMENT CO., New York, N. Y. Booth 501; Third floor.

This company will exhibit its Pyro line of industrial instruments in simplified form; used, both in optical and radiation type, practically the same as a telescope, without outside wires. Another feature will be the Pyro tachometer.

QUEEN'S RUN REFRACTORIES CO., INC., Lock Haven, Pa. Booth 569; Third floor.

This company's exhibit will consist of fire brick especially adapted to power plant furnaces; also special shapes of intricate design for furnace construction which will interest power plant engineers.

QUIGLEY FURNACE SPECIALTIES CO., 26 Cortland St., New York, N. Y. Booth 89; First floor.

Refractory cement for laying up of boiler walls, construction of boiler baffles and patching of furnace lining. Acid proof cement for use on acid resisting masonry, and the use of Ganisand for lining and repairing industrial furnaces. Demonstration will be made of the Quigley refractory gun for making quick repairs on furnace linings.

RAMSEY CHAIN CO., INC., Albany, N. Y. Booths 292, 293; Second floor.

In addition to a representative display of sprockets, pinions and chains, two operating exhibits will be shown. One of these will be a large panel with nine different sized sprockets, each having suspended freely a Ramsey silent chain. Motor drive will operate these sprockets at speeds from 1200 to 1500 r.p.m., showing that the chains assume practically the same form in operation as at rest, except for a slight widening of the loop at the bottom, to demonstrate that the roller bearing compensating joint reduces

friction to a minimum and transmits smooth power at high speeds. Another exhibit will be a large frame carrying a 27-tooth sprocket with 12¼-in. face, from which will be suspended a chain of 1 in. pitch, 12 in. wide and 94 links long. This sprocket operated by motor at a lineal speed of 3100 ft. per min. will again demonstrate the ability to operate, even in heavier types, at high speeds, smoothly and without heating.

THE RAWLPLUG CO., INC., 66 W. Broadway, New York, N. Y. Booth 668; Fourth floor.

Rawlplugs for the holding of screws and bolts into masonry will be shown, also fibre screw-anchors and drills for fast cutting into masonry which can be resharpened on the job.

READING STEEL CASTING CO., INC., 929 Connecticut Ave., Bridgeport, Conn. Booth 48; First floor.

Cast steel gate valves in various types with rustless steel trim and with monel trim. 18-in. iron body gate valve with Dean control, also 12-in. cast steel gate valve with motor control and 12-in. cast steel tee. Special underwriters check valves and bronze valves of all types and sizes. Photographs showing features of construction.

REED AIR FILTER CO., 215 Central Ave., Louisville, Ky. Booth 209-A; Second floor.

Self cleaning air filters demonstrating the construction and action of streamline filtering media and the arrangement of filter body distributor and oil cleaner. Plant will be shown in operation to demonstrate the cleaning and recharging method.

REEVES PULLEY CO., Columbus, Ind. Booth 26; First floor.

Complete display will be made of all types of Reeves variable speed transmissions for providing variable speed control in a campact mechanical unit. Special new features will be the vertical design transmission, the electrical remote control type and an automatic electrical control.

THE RELIANCE ELECTRIC & ENGRG. CO., 1042 Ivanhoe Rd., Cleveland, Ohio. Booths 620, 621; Fourth floor.

Alternating and direct current motors for constant and adjustable speed will be shown. The exhibit will stress particularly various motor protections that can be supplied for unusual services, in places where motors are subject to severe conditions.

THE RELIANCE GAUGE COLUMN CO., 5902 Carnegie Ave., Cleveland, O. Booth 81; First floor.

This year the company's exhibit will include an all

forged steel Reliance safety water column designed for 750 lb. working steam pressure and fitted with two seamless nickel floats made by electro depositing the nickel on a form. The column will have two alarm valves, one for high and one for low water, made of steel forgings, attached to the outside of the column by studs and fitted with hardened, ground and lapped seats and discs, these valves being easily removable without opening the column caps. Seats and discs are also replaceable in the valve body. Top and bottom valves for shut-off are of forged steel with renewable chrome silicon seats and discs glasses are in forged steel cases, with glass of flat type, having mica between the glass and water to prevent action of water on the glass. 14 in. of visible water line variation will be given with 21 in. centers between water gage fittings. Gage cocks designed for 1500 lb. working pressure are used, the portion screwing into the column being of steel and the seats and discs renewable of chrome-silicon, ground and lapped. Another feature will be a forged steel column for 450 lb. working pressure in section to show the working parts, a semi-steel column for 250 lb. working pressure, likewise sectioned, and sample showing the process of manufacture of Reliance solid shell floats. Included in the exhibit will be sectional models of electric alarms and low pressure columns for heating boilers, also sections of gage cocks and alarm valves.

REPUBLIC FLOW METERS Co., 2240 Diversey Pkwy., Chicago, Ill. Booth 6; First floor.

Chief of the features of this exhibit will be the new type Republic boiler meter panel which will include a multiple recorder for giving six individual records simultaneously on one wide strip chart. In connection with these panels will be a large animated cross section view of a modern type boiler showing meter connections at points where readings are taken, the display designed to show the relationship between the various boiler records and their importance for efficient boiler operation. Included in the exhibit will be a complete line of Republic instruments including steam flow meters, water meters, CO_2 meters, draft instruments, duplex and single record pyrometers, indicating pyrometers, and indicators and recorders for liquid level.

RICHARDSON SCALE Co., Clifton, N. J. Booths 283, 284; Second floor.

Richardson apron feed automatic crushed coal scale used for weighing direct from overhead bunker to hopper of automatic stoker or pulverizer will be shown in a full size model, illustrating the method of weighing coal consumed by each individual boiler automatically. The scale will be supplied from an overhead hopper which in turn is filled by a drag conveyor. The scale weighs the material and automatically discharges it into a lower hopper representing the supply for the furnace, the entire exhibit being reproduction of an actual fuel scale installation.

RILEY STOKER CORP., Worcester, Mass. Booths 79; First floor.

Latest developments in a stoker field, an air-zoned Riley superstoker will be shown with furnace depth of 11 ft. 3 in. and divided into five separate air zones. Air pressure in each zone is controlled by the operator from the side of the furnace and can be varied in each one independently, an air chute cap being placed at the front of the stoker. Also will be shown the Atrita unit pulverizer which has been redesigned to give greater fineness of product and longer life to the pulverizing elements. Piped to this will be a Riley flare type pulverized coal burner, which has been in operation for over a year and gives a fuel range of ten to one. A new Jones stoker unit with compact arrangement of driving motor, forced draft fan and gear box will also be shown.

THE ROBERTS STEAM SPECIALTY Co., 5325 Stanard Ave., Cleveland, Ohio. Booth 711; Fourth floor.

Safety water columns and fittings will make up the display of this company. The columns will be shown in cast and forged steel and included in the fittings will be water gages with chain lever, Diamond weighted-lever gage cocks, gage light for illuminating water gages, seamless copper floats for both high and low pressure, laminated steel floats for high pressure, the master single wall float, nickel or chromium plate, for high pressures and superheat, and floats made from nickel, monel, ascoloy, enduro, alcumite and aluminum.

ROCHESTER ELECTRIC PRODUCTS CORP., 85 Allen St., Rochester, N. Y. Booth 655; Fourth floor.

This company will exhibit its diverter pole motor generator set for floating with storage battery on the line to carry normal load and at the same time keep the battery fully charged, so that it is always available for emergency power. The set will be shown in operation on a resistance load to demonstrate regulation and performance.

ROLLWAY BEARING Co., INC., Syracuse, N. Y. Booth 514; Third floor.

Roller bearings for heavy industrial service and roller bearing pillow blocks will be shown here, a special feature being line shaft bearings with adapter pillow block.

ROSS HEATER & MFG. Co., 1407 West Ave., Buffalo, N. Y. Booth 91; First floor.

Cross head guided expansion joints and internally guided joints, heat exchangers, heaters for high and low pressure work, filters, jet and barometric condensers, oil and water coolers.

THE ROTO Co., Newark, N. J. Booth 11; First floor.

This company will exhibit Roto tube cleaners in various sizes and types; also boiler hand hole seat scrapers and cap cleaning machines. Tube cleaners will include equipment as used for cleaning boilers, evaporators, condensers and water-backs.

RUGGLES-KLINGEMANN MFG. Co., Sales, Mass. Booths 558, 559, 560.

Servo motors in both hydraulic and motor-operated types arranged for centralized electrical control will be a main feature in this space. These form a new line of apparatus and can be operated either manually from push-button stations, or automatically from a master regulator. Another feature will be a new line of solenoid-operated valves. The exhibit will include the company's standard line of step action regulators, hydraulic and motor-operated, for maintenance of constant pressure, differential pressure, temperature. Chronometer valves will also be exhibited.

SARCO Co., INC., 183 Madison Ave., New York, N. Y. Booth 33; First floor.

Steam traps for the industrial field, standard and special regulators for hot water and steam service and process systems, regulators for refrigeration service will be included. Special features will be the complete Sarco heating line, inlet valves, traps and other apparatus for low-pressure, vacuum and vapor systems. Also a chill bath with water circulation thermostatically controlled for maintaining temperature of 10 deg. Cent. within 0.1 of a degree. This bath is designed for testing glue and gelatin samples.

SAUERMAN BROS., 438 S. Clinton St., Chicago, Ill. Booths 520, 521; Third floor.

Motion pictures of various types of Sauerman installations for storing and reclaiming coal and other bulk materials will be an attraction at this booth. The entire display space will be taken up by the moving picture apparatus and by a working model of a typical Crescent power drag scraper installation showing the method of storing and reclaiming coal on ground space adjacent to a power plant. The model will also illustrate the handling of other bulk materials besides coal.

SCHUTTE & KOERTING Co., Philadelphia, Pa. Booths 334, 335; Second floor.

Jet devices for pumping liquids, heating liquids and handling air and gases will be shown. These will include the company's multi-jet condenser, stop check valve, piston valves, steam purifier, Helpbringer electric control with motor-operated reducing valve, steam jet thermo compressor, Radiafin tubes, spur and herringbone gear pumps and injectors. Photographs and catalogs will be displayed covering the above equipment and also fuel oil burning systems and valves.

SCOVILLE MANUFACTURING Co., Waterbury, Conn. Booth 69; First floor.

Condenser tubing of admiralty metal and of Muntz metal, heat exchanger tubing, free cutting brass rod and examples of the special brass products which the company is equipped to make.

SHAFER BEARING CORP., 6501 W. Grand Ave., Chicago, Ill. Booth 703; Fourth floor.

This company will exhibit self-alining roller bearings in a complete range of sizes, also a newly designed self-alining pillow block and hanger bearing, the box of which has a spherical outer surface, carried upon rollers, whose outer bearing is against spherical shaped races.

THE SHARPLES SPECIALTY Co., 23rd and Westmoreland Sts., Philadelphia, Pa. Booth 92; First floor.

This exhibit will include a No. 6 Sharples transformer and lubricating oil purifier of portable model; a 1928 model Presurtite or totally enclosed super centrifuge; a cross section model of the super centrifuge showing the entire working mechanism. Also a scene-in-action animated picture will be displayed, depicting in colors the actual workings of the super centrifuge.

SHEPARD ELECTRIC CRANE & HOIST CO., Montour Falls, N. Y. Booth 632; Fourth floor.

Display panels will be shown with photographic enlargements of the complete Shepard line of hoisting equipment in capacities from ¼ up to 30 t. and, in operation, will be shown the company's close clearance hoist.

JOHN SIMMONS CO., 110 Centre St., New York, N. Y. Booth 519; Third floor.

Piping and accessories; photographs and illustrations of piping installations made by this firm.

SIMPLEX VALVE & METER CO., 68th and Upland Sts., Philadelphia, Pa. Booth 76; First floor.

Here will be found in cross section a Simplex meter register of indicating, recording and totalizing type for use with a Venturi meter, mechanically operated to illustrate the functioning of the internal parts of the meter. Another feaure will be the company's latest type metering equipment for power plants to be used on lines for boiler feed, condensate make up and other water measurement.

SKF INDUSTRIES, INC., 165 Broadway, New York, N. Y. Booths 332, 333; Second floor.

Ball bearings in all types, including radial, thrust, double row and self alining bearings, also applications of ball bearings to hangers and pillow blocks.

SKIDMORE CORP., 1535 Dayton St., Chicago, Ill. Booth 456; Third floor.

Vacuum pumps for condenser and heating systems with diaphragm vacuum control and magnetic time limit.

M. B. SKINNER CO., 558 Washington Blvd., Chicago, Ill. Booth 258; Second floor.

Pipe joint clamps, service saddles, pipe saddles, flange clamps and reseating tools.

F. L. SMIDTH & CO., INC., 50 Church St., New York, N. Y. Booths 281, 282; Second floor.

Automatic action of the Lenix short center belt drive will be illustrated by a model showing the response to variation of load applied to the driven pulley. Another model will demonstrate, by the stroboscopic visual method, the power lost due to belt slip. Full size equipment of the drive will be included in the exhibit.

SMITH & SERRELL, Globe Indemnity Bldg., Newark, N. J. Booth 85; First floor.

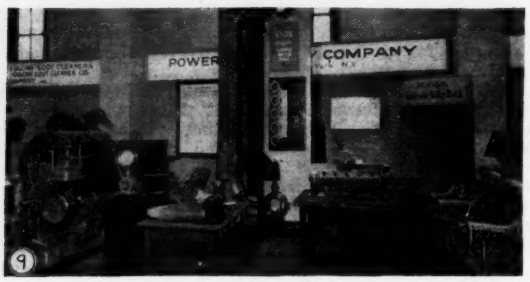
Francke flexible couplings of all types will make up this display. Included will be the bushed laminated-pin type, which is for general use on power drives, the operation of the couplings being demonstrated by a section of shafting with three couplings mounted upon it in suitable bearings, illustrating how endwise movement or displacement of connected shafts is taken care of, how angular misalinement is handled, also how radial or out of center misalinement is provided for. As a special feature, the spring cushioning fit effect of these couplings in absorbing shock loads and vibrations will be demonstrated by flexible pin units of the couplings which can be examined in detail. Models of couplings for high speed and of double floating ring type for severe operating conditions, also of fractional horsepower type will be shown.

SMOOT ENGINEERING CORP., 136 Liberty St., New York, N. Y. Booths 417, 418, 419; Third floor.

Smoot control of combustion will be shown, regulating the input of fuel and air to a gas-fired boiler, steam output of the boiler being variable for minimum to maximum continuously. The demonstration will show control of uniform steam pressure by the master controller and constant percentage of CO_2 in flue gases. Another feature will be the gas density regulator in operation, determining the CO and CO_2 and thus detecting any changes in fuel character or other elements affecting combustion.

SNAP-ON WRENCH CO., 14 E. Jackson Blvd., Chicago, Ill. Booth 449; Third floor.

Electrically operated demonstration of wrenches in action with time and motion study charts to show savings on construction and repair jobs will be a chief attraction. New tools will be Snap-on sockets and shanks for power nut-



driving machines, a newly developed set for work in cramped quarters where ordinary socket wrenches are unavailable. Complete lines of wrenches, chisels, punches and other hand tools will be included.

SOWDON & GREENE, INC., 342 Madison Ave., New York, N. Y. Booth 76; First floor.

Apparatus and illustrations of installations will be found in this booth covering spray ponds, water column fittings and water gages of various types, pulverized coal equipment, pump governors, Venturi and Pitot tube meters, controls for water systems, condenser systems, pumps, oil systems, air compressors, paper machines and water gas apparatus.

SPENCER TURBINE CORP., Hartford, Conn. Booths 452, 453; Third floor.

Turbo compressors for supplying air from 1 to 3 lb. pressure in sizes from 7.5 hp. up.

SPRINGFIELD BOILER CO., Springfield, Ill. Booths 31, 32; First floor.

Springfield peep hole doors for inspection of fire; details of Springfield water tube boilers and blueprints and photographs of installations of the standard and double deck type for stoker and for pulverized fuel use.

C. E. SQUIRES CO., E. 40th St. and Kelley Ave., Cleveland, O. Booth 663; Fourth floor.

Complete line of Squires steam specialties will be found in this space. This will include the genuine Squires steam, air and gasoline traps, also reducing and regulating valves, pump governors and automatic boiler feed water controllers.

STANDARD STEEL & BEARINGS, INC., Plainville, Conn. Booth 336; Second floor.

Ball bearings in single and double row annular type, also thrust bearings and data covering process of production, manufacture and testing.

STERLING ENGINE CO., 1250 Niagara St., Buffalo, N. Y. Booths 446, 447; Third floor.

Gasoline engines for driving pumps and generators and other mechanical service, with counter weighted crankshaft permitting operation as high as 1200 r.p.m.

B. F. STURTEVANT CO., Hyde Park, Boston, Mass. Booths 410 to 414 and 483, 484; Third floor.

Draft fans, steam turbine with automatic control, air preheaters, ventilating equipment, and vacuum cleaners will

make up these exhibits. Of draft fans, the new Turbovane for induced draft will be shown with automatic control device for squirrel cage motors. Also the forced draft design with alloy steel blades and heavy construction of plates, shafts and bearings. Automatic control of the steam turbine permits of opening and closing of nozzle valves according to demands on the fan. Air preheaters of plate type with removable and reversible chambers permit changing from cold to hot end if corrosion makes it desirable. Tubular air preheater construction with lead-coated tubes will be exemplified. For household use, a coal burning blower to permit the use of buckwheat coal, the Wind-O-Vane fan for ventilating kitchens, propeller fans for ventilating public rooms, a unit ventilation for schools, a unit heater for factories and model 15 household cleaner will be demonstrated in actual operation. Vacuum cleaning for industrial plants will be demonstrated by working models in booths 483-4.

SUPERHEATER CO., 17 E. 42nd St., New York, N. Y. Booth 56; First floor.

Units from superheaters which have been in service for a number of years, showing the results of operation at high temperatures and under severe operating conditions.

THE SWARTWOUT CO., Cleveland, Ohio. Booths 696, 697; Fourth floor.

Complete line of "S-C" products, including high and low-pressure feed water regulators, Type S differential pressure valves for feed water regulation, motor-driven boiler feed pump regulators, feed-pump governors, drainage control, master control for pressure reducing and regulation, feeder control apparatus and other steam products will be included. Special demonstration will be made of feed water regulating and pressure regulating apparatus, also of high and low-pressure steam traps, separators for air and steam, exhaust heads and feed water heaters. Operating and working exhibit of Swartwout ventilator.

SWEET & DOYLE, Troy, N. Y. Booth 477; Third floor.

Two machines will be shown, a Universal power collar folding machine, and a semi-automatic garter pad folding machine, both for use in the textile industry.

C. J. TAGLIABUE MFG. CO., 18 Thirty-Third St., Brooklyn, N. Y. Booth 59; First floor.

Here the feature will be a steam-operated controller for temperature or pressure with simple thermostatic control for feed water heaters, oil heaters, hot water tanks and the like. Another feature will be a new line of TAG air operated controllers for pressure, temperature, humidity, condensation and other conditions; also recording thermometers, pressure and vacuum gages in a new 12-in. size, as well as the older 10-in. size. Distant reading mercury recording thermometer will be demonstrated and a new electrically-operated Mono flue gas analysis indicator recorder for indicating and recording CO as well as CO_2. Oil testing instruments for viscosity, gravity, color, flash and fire tests will be shown and the usual line of etched stem laboratory thermometers.

W. O. & M. W. TALCOTT, INC., 91 Sabin St., Providence, R.I. Booth 723; Fourth floor.

Belt fasteners and demonstration of the breaking strain of various styles. Demonstration of the method of application of Talcott belt hooks, also a new type of plate and rivet fastener, for insertion between middle plies.

TAYLOR INSTRUMENT COMPANIES, Rochester, N. Y. Booth 507.

Main features of this exhibit will be a complete display of instruments manufactured by the companies, with the Tycos trade mark for use in power plants and industrial fields to measure temperature, pressure and control these values. Among the products shown will be thermometers of industrial and index dial type, test thermometers with engraving on the glass, pyrometers, long distance transmitting recording instruments for pressure and temperature, recording thermometers and pressure gages, temperature and pressure regulators, hygrometers and aneroid and mercurial barometers.

THE TERRY STEAM TURBINE CO., Hartford, Conn. Booths 207, 208, 209; Second floor.

Exhibit will be made of Terry turbines and parts, also herringbone gears, flexible shaft couplings, and the Terry turbine stoker drive. Rotor of a 500-kw., multi-pressure turbine will be shown and a standard Terry turbine with cover raised to show the solid one-piece wheel. Terry herringbone gears for speed increasing or reducing service will be displayed, also flexible shaft couplings specially designed for turbine speeds. A particular feature will be the turbine stoker drive, an entirely new machine designed for direct connection to the power box of stokers. This is self-contained and equipped with variable-speed governor.

TEXAS CO., 17 Battery Pl., New York, N. Y. Booths 641, 642; Fourth floor.

Demonstration of the methods of preparing the Texas Company's lubricants, samples of its products and data on proper lubrication for different classes of machinery.

TIDE WATER OIL CO., 11 Broadway, New York, N. Y. Booth 15-A; First floor.

Industrial lubricating oils and greases, with methods of determining requirements for various classes of service.

TIMKEN ROLLER BEARING CO., Deuber and 20th St., Canton, Ohio. Booth 2-N; Second floor.

Tapered roller bearings in detail and in all sizes for application to industrial use. Devices to demonstrate the saving in power by use of non-friction bearings, special bearings as used in railroad journal boxes and Timken equipped line shaft bearings.

TOLEDO PIPE THREADING MACHINE CO., Toledo, Ohio. Booth 720; Fourth floor.

Power drives, pipe cutters and pipe threading tools will be shown, also high speed production pipe machine for cutting, threading and reaming pipe from ⅛ to 2 in. in size. Threading tools and cutters will be shown covering pipe size range from ⅛ in. to 12 in. and demonstration will be made of the operation of the tools.

TOLEDO SCALE CO., Monroe and Albion Sts., Toledo, Ohio. Booths 724, 725; Fourth floor.

Scales of all types for continuous weighing and automatic recording, also for platform and truck weighing.

TOPPING BROS., 156 Varick St., New York, N. Y. Booths 512, 513, 524, 528; Third floor.

Torchweld equipment, simplex jacks, cored bar products and Detroit twist drills.

TORCHWELD EQUIPMENT CO., 224 N. Carpenter St., Chicago, Ill. Booths 527, 528; Third floor.

Torchweld equipment will be displayed for gas welding and cutting, lead welding, decarbonizing, also welding accessories and supplies. Demonstration of the uses of this apparatus will be made.

TRILL INDICATOR CO., 34 E. South St., Corry, Pa. Booth 745; Fourth floor.

Trill indicators will be exhibited and demonstrated in this space in various types. A single card indicator, also two types of continuous card indicators. The Corry noiseless rotating check valve will be demonstrated and the Trill direct reading planimeter will be shown. The continuous card indicator will be in actual operation during the time of the show.

TRI-LOK CO., 5555 Butler St., Pittsburgh, Pa. Booths 401, 402; Third floor.

Tri-Lok grating, constructed of steel bars with triple lock distributing bars at right angles. The exhibit will show the adoptation of this grating for reenforcement of concrete floors, use for safety steps, gratings and runways.

TRIPLEX MACHINE TOOL CO., 50 Church St., New York, N. Y. Booths 646, 647, 661.

Special machine tools will be shown, including the Swiss jig boring machine, Mikron gear hobbing machine, Williams pipe machine, and Edlund drill presses.

UEHLING INSTRUMENT CO., 423 Getty Ave., Paterson, N. J. Booth 45; First floor.

Meter for showing fuel wasted up chimney by recording CO_2 percentage and flue gas temperature on one chart. Also combined barometer and vacuum recorder.

UNISHEAR CO., INC., 175 Fifth Ave., New York, N. Y. Booths 475, 476; Third floor.

Models A and O of the Unishear for cutting straight lines, curves and complicated designs in sheet metals, also of Model D with capacity up to ¼ in. thick steel plate.

UNITED STATES ELECTRICAL TOOL CO., 2490 W. 6th St., Cincinnati, Ohio. Booth 700; Fourth floor.

Portable electric drills, grinders and polishers for all purposes.

VINCENT-GILSON ENGINEERING CO., INC., 30 Church St., New York, N. Y. Booth 17; First floor.

Representing the Diamond Power Specialty Co., Andrews-Bradshaw, Smith Gas & Engineering Co., Warren Steam Pump Co., Carling Turbine Blower Co. and the Engineer Co., this firm will exhibit all these various products, including the soot blowers, the Tracyfier for purification of steam, gas producers, steam pumps, blowers and boiler baffling.

HENRY VOGT MACHINE CO., 10th and Ormsby Sts., Louisville, Ky. Booths 269, 270; Second floor.

Exhibit will be made of the company's regular line of drop forged steel valves and fittings for high pressures and

temperatures as used in refineries, central stations and other plants. Part of the space will be taken up with a boiler exhibit featuring an electric sign of large proportions to show the internal workings of the Vogt water-tube boiler.

VULCAN RADIATOR CO., 73 Homestead Ave., Hartford, Conn. Booth 407; Fourth floor.

Tubes with extended surface will be shown in various forms, such as radiators, hot blast heaters and heating cabinets.

VULCAN SOOT CLEANER CO., DuBois, Pa. Booth 19; First floor.

Self contained Vulcan valve operating head and late developments for the control of soot cleaner installations. Crodon and super-Crodon blower elements for resisting corrosion.

WAILES-DOVE-HERMISTON CORP., 17 Battery Pl., New York, N. Y. Booths 261, 263; Second floor.

Special construction and methods of lining coal and ash bunkers showing the materials used, including Bitumastic and Hermastic paint and enamels for prevention of corrosion of metal surfaces.

WAITE & DAVEY CORP., 17 E. 42nd St., New York, N. Y. Booth 58; First floor.

Suspended arches, air cooled side walls and rear combustion arches, for giving air preheated up to 500 deg.

J. D. WALLACE & CO., 134 California Ave., Chicago, Ill. Booth 692; Fourth floor.

Portable, motor-driven wood working machinery, including bandsaw, universal saw, jointer, lathe, handsaw, mortiser. Electric glue pot and various cutting tools.

WALSH & WEIDNER BOILER CO., Chattanooga, Tenn. Booth 72; First floor.

Longitudinal section will be shown of the latest type 54-in. steam drum for 450 lb. working pressure with heads shrunk on the outside ends of the shell, high pressure manhole and other special features of construction. Also will be shown two standard high-pressure forged steel sectional headers and a 1400-lb. working pressure sectional header. Section of the Walsh & Weidner special entire water covered water wall will be exhibited; a new special high-pressure water gage with small cross sections of various parts of the company's equipment. Large photographs and drawings will be shown of a number of high pressure installations.

WALWORTH CO., Boston, Mass. Booths 44, 308, 309, 310, 311; Second floor; 44-A; First floor.

Valves for steam service will be featured, from standard pressures, up to 1350-lb. Valves with Sigma steel bodies and Sigmalloy trim. Valves for lower pressures will be shown in section, mounted on mahogany display boards. Larger valves will be demonstrated with motor-drive operation. Kewanee unions will be shown under air pressure test in a special testing machine, the same as carried out at the factory.

WARREN STEAM PUMP CO., INC., Warren, Mass. Booth 231; Second floor.

Centrifugal and steam-driven reciprocating pumps will be the main display. Included in the exhibit will be a 4-in., single-stage, double-suction centrifugal, designed for 3600 r.p.m. and sections showing special features of construction of all types of the company's pumps.

WATTS REGULATOR CO., Lawrence, Mass. Booth 39; First floor.

Feed water regulator of gravity type, reducing valves, pump governors, engine and damper regulators.

WARREN, WEBSTER & CO., Camden, N. J. Booths 225, 226; Second floor.

This exhibit will show Webster systems of steam heating and Webster system equipment, the Series 78 traps and No. 026 drip trap, also Webster Type R systems, with latest developments which have been applied to all these systems.

WESTINGHOUSE ELEC. & MFG. CO., E. Pittsburgh, Pa. Booths 564, 565, 566; Third floor.

Turbine generator units; details of turbine construction; Micarta gears in various sizes and types and illustrations of large turbine plants.

WESTON ELECTRICAL INSTRUMENT CORP., Newark, N. J. Booths 510, 511; Third floor.

Electrical measuring instruments and accessories will be the features in this exhibit, one of particular interest being an electrical speed indicator which will be demonstrated in operation. Portable and switchboard types will be included.

C. H. WHEELER MFG. CO., Lehigh and Sedgley Aves., Philadelphia, Pa. Booth 77; First floor.

Products to be shown will include Radojet air pumps, a three-stage for high vacuum, a two-stage with combined inter and after surface condenser and cross section model of the two stage; also sectional drawing of the Leach Fracto control condenser and of condenser installations and auxiliaries. In the three-stage Radojet pump the three stages are in series with inter condensers between first and second and between second and third stages, this pump being especially used for vacuums above 29.2 in. In the two-stage pump, water in hot or condensate section flows around vertically arranged tubes, while in the cold water section circulating water flows through the vertically arranged tubes. The Leach Fracto condenser has means for separating several distillate fractions by adjustment and control of one of more cooling mediums in the different vapor compartments.

THE WHITNEY MFG. CO., Hartford, Conn. Booth 249; Second floor.

This moving exhibit will cover the three principal lines of Whitney chains for power transmission, the double bearing pin and bushing type silent chain for moderate speeds and heavy loads, rolling joint type of silent chain for high speeds and standard steel roller chain for heavy loads at slow speeds.

WICKES BOILER CO., Saginaw, Mich. Booth 285; Second floor.

In this space will be found a lantern slide machine showing shop operations used in the construction of Wickes boilers, also views of actual installations. The display will include a section of a Wickes patented single joint header as used in horizontal cross-drum boilers, model of the new Wickes three-drum, curved-tube boiler and photographs of installations of this type.

L. J. WING MFG. CO., 9th Ave. and 13th St., New York, N. Y. Booth 61; First floor.

Turbine blowers will be shown of type for supplying forced draft to both stokers and hand-fired boilers, as used to produce individual forced draft in each boiler. Also motor-driven blowers for low-pressure heating boilers, unit heaters of the low ceiling type, in different sizes, the Scruplex exhauster, with driving motor entirely outside the gas current and the Scruplex fan for moving large volumes of air, having a cast blade for the smaller sizes and for larger sizes a fan built up of blades of heavy sheet steel mounted on heavy forged arms.

T. B. WOOD'S SONS CO., Chambersburg, Pa. Booths 479, 480; Third floor.

Power transmission machinery will be shown here, including the U. G. automatic belt contactor, flexible couplings, friction clutches, drop hangers and cast iron pulleys.

WORTHINGTON PUMP & MACHINERY CORP., 115 Broadway, New York, N. Y. Booths 487, 488, 489; Third floor.

Solid injection oil engines, centrifugal pumps, feather valve air compressors, Dean power pumps and water and oil heaters.

WRIGHT-AUSTIN CO., 321 W. Woodbridge St., Detroit, Mich. Booth 255; Second floor.

Victor steam traps, air traps, exhaust heads, steam separators, oil separators, water columns and fittings, strainers.

WRIGHT MFG. CO., Lisbon, Ohio. Booth 698; Fourth floor.

Here will be shown a chain hoist, trolleys and hand cranes, the principal products which this company makes.

"X" LABORATORIES, 25 W. 45th St., New York, N. Y. Booth 259; Second floor.

Demonstration of use of "X" liquid for repairing steam and hot water boilers of high and low pressure type.

THE YALE & TOWNE MFG. CO., Stamford, Conn. Booths 622, 623; Fourth floor.

Electric industrial high lift and low lift trucks will be shown in 2 to 5-t. capacities, also tractors and trailers. Two special features will be the new Yale 3-t. capacity high lift truck and a new model 5-t. capacity low lift truck for industrial use. Included in the display will be chain hoists of differential, screw-geared and spur-geared types; also electric chain hoists, cranes and crane ends.

YARNALL-WARING CO., Chestnut Hill, Philadelphia, Pa. Booths 7-A, 7-B; First floor.

Yarway blowoff valves in a full line for pressures up to 1350 lb. will be shown. Also a working model of a spray pond equipped with Yarway involute spray nozzles. Other Yarway products will be high and low-pressure water columns with Sesure inclined water gages, Lea V-notch meter, hydraulic valves, pipe joint clamps, Holtite pipe clamps.

YOUNG PUMP CO., 450 E. Ohio St., Chicago, Ill. Booths 701, 702; Fourth floor.

Centrifugal pumps for vacuum and for boiler feed, also for the handling of condensation, draining of receivers and general service work.

POWER PLANT ENGINEERING DEVELOPMENTS AND NEWS

Airxpel Bucket Trap for Pressures Up to 400 Lb.

FOR USE WITH steam pressures from 0 to 400 lb., the Airxpel bucket trap, recently announced, is designed with provisions for removal of any air that may be entrained with the condensate to be handled. Construction of the trap is shown in the accompanying views. It is furnished in ½ and ¾-in. sizes, called cub sizes, for pressures from 0 to 200 lb. and for installation directly in the line without other support. For the 0—400 lb. pressures it is furnished in sizes from ½ in. to 2 in.

Of particular interest is the method used to expel air. This is illustrated by the three views. Figure 1

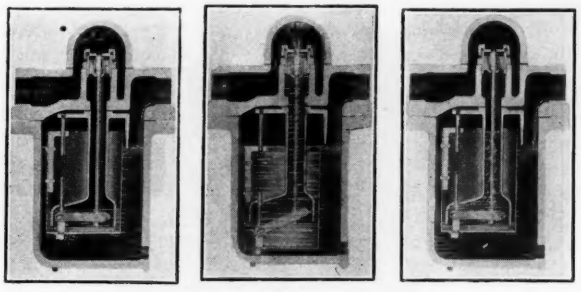


FIG. 1. TRAP CLOSED. FIG. 2. BEGINNING OF DISCHARGE PERIOD. FIG. 3. IMMEDIATELY AFTER DISCHARGE, WATER DESCENDING FROM DISCHARGE TUBE TO BUCKET DRAWS ENTRAINED AIR UP INTO TUBE

shows the trap closed before the incoming condensate fills the bucket. Figure 2 shows the trap beginning to discharge. Conditions immediately after discharge has been completed and the valve closed are as shown in Fig. 3. At this time the discharge tube is full of water; the only way this water can descend into the bucket is by air finding its way into the space above it. There is enough space around the bucket stem for any entrained air to be sucked up into the discharge tube by the descending water seeking its level in the bucket. When the trap discharges the next time, the air goes out first.

Body and cover of the trap are of cast semi-steel for pressures up to 300 lb. and of cast steel for pressures to 400 lb. Bucket is of copper, valve and seat of monel metal and all other parts of steam bronze. Valve and seat are designed to be reversible, the valve holder having spiral vanes to rotate the valve during discharge, thus regrinding it. For reversing or renewing, the valve and seat are reached by removing the valve cap at the top. Pipe connections are horizontal into the cover and the body can be removed without breaking pipe connections. The trap is manufactured by Wright-Austin Co., 315 W. Woodbridge St., Detroit, Mich.

Foster Sectional Air Heater

IN THE ACCOMPANYING illustrations is shown the new Foster sectional air heater recently placed on the market. This is a plate type heater, the plates being formed as shown in Fig. 1, and held in position in the

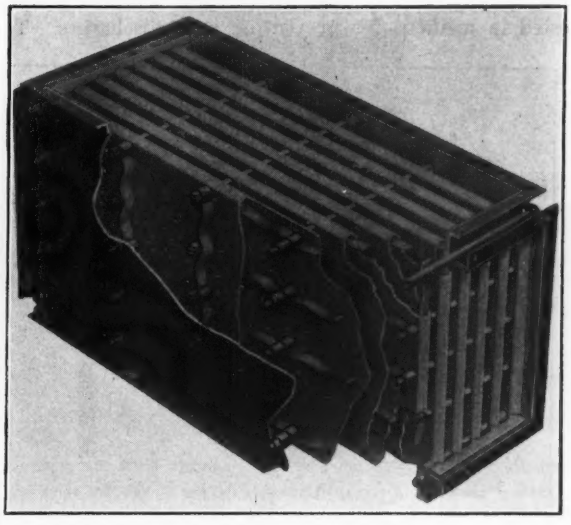


FIG. 1. PLATES SEPARATED BY SPACERS HAVE BAFFLES TO DIRECT HORIZONTAL FLOW OF AIR AND VERTICAL FLOW OF FLUE GAS

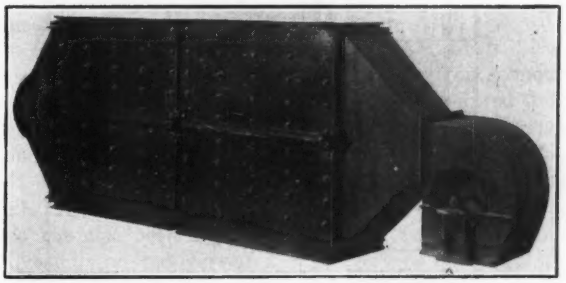


FIG. 2. ONE OF THE VARIOUS ARRANGEMENTS OF HEATER SECTIONS THAT CAN BE MADE TO FIT PLANT CONDITIONS

casing by spacers. This view also shows the baffles designed to insure flow of air and flue gas past all of the heating surface to avoid bypassing. Air passes horizontally and flue gas vertically through the section.

Design of the heater is intended to facilitate easy renewal of individual sections, if necessary, especially at the cold end, where deterioration sometimes occurs.

Hand-operated or motor-operated soot blowers can be provided for cleaning the heater, the baffles helping to maintain the velocity of the steam when blowing. Provision is made in the assembled section to prevent buckling due to expansion and contraction of the plates.

Various arrangements of the individual sections can be made to suit the amounts and temperatures of air and flue gas handled in the individual plant. Figure 2 shows a group of four sections arranged for parallel flow through two pairs of heaters. The new heater is being marketed by Foster Wheeler Corp., 165 Broadway, N. Y., which is issuing catalog A-H-7 describing it.

Cindertrap for Cleaning Flue Gas

OWING TO the objections sometimes raised to the discharge of cinders from the chimneys of power plants, engineers are becoming more and more interested in methods for preventing such discharges. The

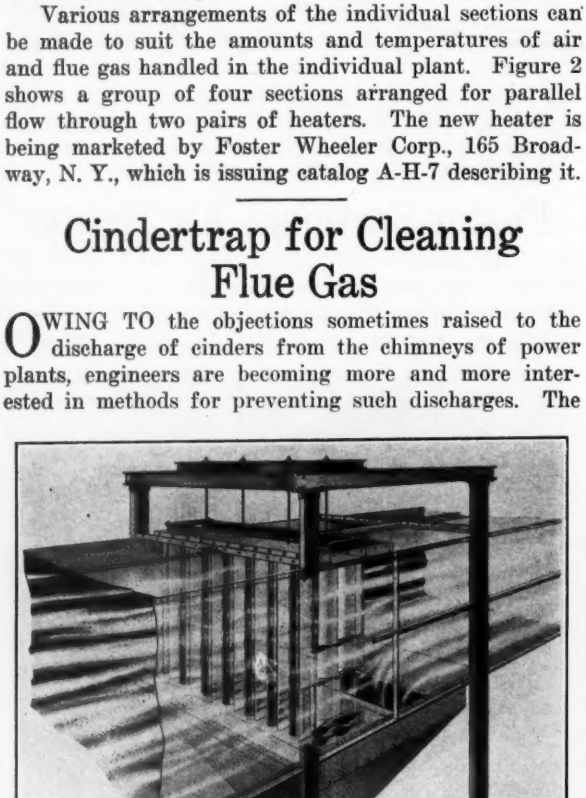


FIG. 1. CINDERTRAP IS INSTALLED IN A HORIZONTAL PORTION OF THE SMOKE FLUE

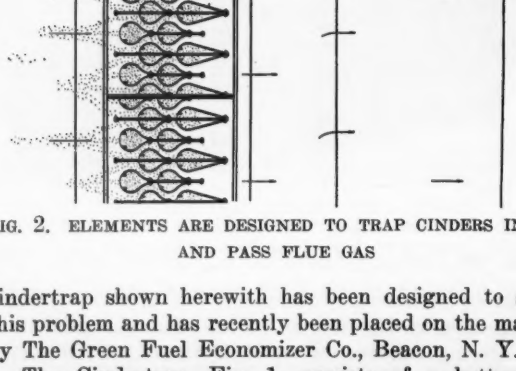


FIG. 2. ELEMENTS ARE DESIGNED TO TRAP CINDERS INSIDE AND PASS FLUE GAS

cindertrap shown herewith has been designed to solve this problem and has recently been placed on the market by The Green Fuel Economizer Co., Beacon, N. Y.

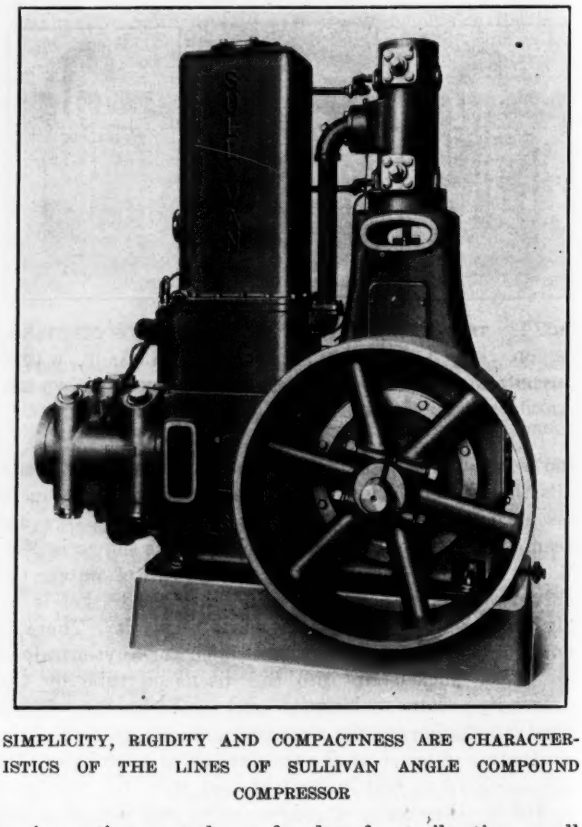
The Cindertrap, Fig. 1, consists of a battery of vertical elements arranged in staggered double rows, mounted in a casing of suitable design and strength ready for installation in a horizontal portion of the smoke flue. A bin or hopper is placed below, into which the lower ends of the trap elements project. The elements are of the form shown in Fig. 2.

In operation the Cindertrap elements are intended to divide the flue gases containing cinders into vertical strata, which make sudden change in direction, and to cause the cinders to be trapped in the elements and drop into the hopper below. Some of the gas passes down with the cinders, but returns to the flue through the opening behind the elements, baffles preventing any cinders from going through.

It is stated that on test the Cindertrap has removed 80—96 per cent by weight of solids from flue gas, and that the draft loss, at 450 deg. and a velocity of 3000 ft. per min. does not exceed 0.16 in. of water.

New Angle Compound Compressor

SULLIVAN MACHINERY CO., Chicago, Ill., has developed an improved high pressure angle compound compressor for air and gas. Outstanding characteristics of this compressor are: Careful balancing of



SIMPLICITY, RIGIDITY AND COMPACTNESS ARE CHARACTERISTICS OF THE LINES OF SULLIVAN ANGLE COMPOUND COMPRESSOR

reciprocating parts hence freedom from vibration, small floor space requirement, small and light requirement for foundations, adaptability to varying forms of drive, low power cost per unit of gas or air compressed, low cost of maintenance, small attendance requirement and accessibility.

These units are built to withstand the burden of continuous operation and are easily moved and operated on temporary foundations. They are readily mounted on skids with an idler bracket for short center connection. Installation of the complete unit consists of little more than skidding it into proper position, connecting up the piping and making the electrical connections. The compactness of the units and their light weight are such that it can be readily handled over rough country.

Adaptability to varying working requirements is easily met by changes in compressor cylinder sizes. Numerous cylinder sizes, all of which are interchangeable on any of the 8 in. stroke frames, including various combinations from 8 and 3⅜ by 8 to 10 and 4½ by 8 with corresponding capacities from 266,400 to 417,600 cu. ft. per 24 hr. are available. Speeds of all sizes are 400 r.p.m. Pressures have been carried as high as 1000 lb. The arrangement of the cylinders at right angles to each other permits the locations of both connecting rods side by side on the same crankpin.

Lubrication of the main working parts is by a self-contained gravity system and forced feed for the cylinders. The lower part of the main frame forms a reservoir for lubricating oil which is subsequently pumped to an overhead reservoir.

"Wafer" type, air actuated valves are used throughout. They are employed in multiples of relatively small size, thus reducing the pocket clearance and the likelihood of noisy action. These valves are held to their seats by flat annular springs. They open against specially designed guard plates intended to give a wide port opening with a minimum of clearance volume, and without restricting the admission and discharge of the air. A pop safety valve of ample size is provided between the low pressure cylinder and intercooler to prevent undue rise of pressure.

Intercoolers are placed vertically on all but the largest sizes on which they are placed horizontally. The intercooler is of the two pass type and is specially designed to withstand the high pressures encountered. Air passes through the tubes and water surrounds them. Fins surrounding the pipes are used to aid in the heat transference.

News Notes

ON DECEMBER 7 at 10 a. m. the annual meeting of the Board of Advisory Engineers of the Power Transmission Association will be held at the Hotel Commodore, New York City. The meeting will open with remarks by Chairman Staniar, and discussion of the proposed Staniar Power Transmission Association Handbook. Proposed recommendations to the association will be discussed and, at 1 p. m., there will be a joint luncheon with the members of the association. Possibility of joint activities with the American Society of Mechanical Engineers will be discussed by W. Batt, president of SKF Industries and R. T. Kent, Chairman, A. S. M. E. Standing Committee on Professional Divisions. This will be followed by an address on Mechanical Power Transmission Economies by William Staniar, Belting & Transmission Engineer, E. I. duPont de-Nemours & Co. While the Board of Advisory Engineers is meeting in the Tavern Room in the morning, the members of the association will have an important meeting in the West Ballroom of the Commodore Hotel to hear reports on Surveys and of the Merchandising Advisory Committee. Manufacturers of mechanical power transmission equipment are invited to attend.

JOHN J. O'BRIEN, president of H. M. Byllesby & Co., announces that the Standard Gas & Electric Co. has acquired the properties of the Wisconsin Valley Electric Co. and subsidiaries with headquarters at Wausau, Wis. The latter company serves a total of 25 cities and towns with a combined population of 90,000, and operates hydroelectric and steam stations with combined generating capacity of 24,000 hp.

EDWIN H. LUNDGREN, for the past 4 yr. general sales manager of the Combustion Engineering Corp., has recently been elected vice president and general sales manager. Mr. Lundgren has been actively identified with the stoker business since 1912, association with the Combustion Engineering Corp. beginning in 1921, at which time he resigned as vice president and chief engineer of the Frederick Engineering Co., Frederick, Maryland,

to come to New York. He is a graduate Mechanical Engineer of the Swedish Government Technical College and author of numerous technical articles on the design and construction of stokers.

ERIE CITY IRON WORKS, Erie, Pa., announces that J. R. LeValley has been appointed special representative for the company. Mr. LeValley has had extensive engineering experience in the U. S. Navy and also with the Superheater Co. and the Motor Fuel Corp. For two years he was chief operating engineer for Armour & Co., Chicago. The company has also appointed Joel Ecklund sales engineer. Mr. Ecklund has had experience in engine design with Allis-Chalmers Mfg. Co., and served in various important engineering positions with the U. S. Gypsum Co., for 12 yr. C. O. Hoban, who has also been appointed special representative for the company, has served for the past seven years as erection and traveling engineer for Riley Stoker Corp.

VOLUNTARY PETITION in bankruptcy has been filed by the Locomotive Crane Co. of America of Champaign, Ill., in the federal court in Danville, Ill., and W. W. Hoag of Champaign has been appointed receiver under a $10,000 bond. The company listed assets of $29,136.07 and liabilities of $121,813.64. The action followed judg-

ments secured in the Champaign County courts for sale of office equipment and factory plant to satisfy creditors' claims. The organization is a Delaware corporation.

CHAIN BELT CO., Milwaukee, Wis., announces the purchase of the mortar and plaster mixer business of the Atlas Engineering Co.

YEOMANS BROTHERS CO., 1433 Dayton St., Chicago, Ill., announces the appointment of Dempster Mill Mfg. Co., Amarillo, Texas, as its representative in northwestern Texas.

THE BROWN INSTRUMENT CO., Philadelphia, Pa., announces the opening of a branch office at Kansas City, Mo., at 509 Mutual Bldg., in charge of F. M. Poole, district manager.

ROBERT W. GILLISPIE, for many years, was connected with the Bethlehem Steel Co. in an executive position and joined the organization of the Jeffrey Mfg. Co. of Columbus, Ohio, as vice-president and assistant general manager in July, 1926. On October 10, 1927, his election was announced as vice-president and general manager of the Jeffrey Co. to take effect at once.

CHARLES C. PHELPS, Combustion Engineer, announces his removal from Paterson, N. J., to Room 528, 30 Church St., New York City, where he will act as representative for various manufacturers of power plant equipment.

WILLIAM H. HODGE has been elected a vice-president of the Byllesby Engineering and Management Corp. and placed in charge of a newly created Sales and Advertisement department at the Chicago headquarters. Mr. Hodge has been with the organization since 1910 as manager of advertising and publicity, taking a prominent part in the development of the customer ownership plan of financing public utilities as well as in public relations activities.

THE UNITED GAS IMPROVEMENT CO., Philadelphia, Pa., announces that H. Craig Sutton has been appointed electrical engineer of the company and K. M. Irwin has been appointed mechanical engineer of the electrical department.

THE BOILER ENGINEERING CO., 931 Federal Trust Bldg., Newark, N. J., is now being represented in the Detroit territory by E. W. Nicklin Co., General Motors Bldg., Detroit, Mich.

THE CONDON ENGINEERING CO., 230 S. La Salle St., Chicago, Ill., has plans under way for a new steam power plant in Sebree, Ky., and expects to ask for bids early in January.

THE ILLINOIS POWER AND LIGHT CO. has completed a 16-mi. gas main between its Galesburg, Ill., plant and Monmouth, where it connects into mains already used by the Monmouth company. The line cost $125,000. It is 4-in. steel welded, with pressure from 5 to 50 lb. A new storage tank of 500,000 cu. ft. capacity has also been constructed in Galesburg to be added to the general system to supply pressure for the new line.

THE FOUNDATION CO., Los Angeles, Calif., is making plans for the construction of a new power plant at the new local mill of the B. F. Goodrich Co., Akron, Ohio.

THE STAMFORD GAS & ELECTRIC CO., Stamford, Conn., has completed plans for an addition to its steam power plant on South St., reported to cost about $100,000 with equipment.

THE PENNSYLVANIA RAILROAD, Broad St. Station, Philadelphia, Pa., has plans under way for a new coal storage and refrigerating plant at the recently completed Pennsylvania Produce Terminal. This unit will contain approximately 2,000,000 cu. ft. The Day & Zimmermann Engineering & Construction Co., Sixteenth and Walnut Sts., Philadelphia, has been engaged to design the project, co-operating with W. H. Cookman, architect for the company.

THE W. B. FOSHAY CO., Minneapolis, Minn., continues its expansion program by purchasing utilities in Arizona, Idaho and Montana.

THE NEW ENGLAND POWER CO., Worcester, Mass., is reported to be considering construction of a hydroelectric plant on the Connecticut River near Dalton, N. H.

LEHIGH TRACTION CO., Hazleton, Pa., is considering the construction of a new steam power plant to be used for its own power requirements as well as those of the Wilkes Barre and Hazleton Railway and coal mining interests in that section.

THE HALLTOWN PAPER BOX CO., Halltown, W. Va., announces through its Vice-President, Mr. Nelson, that Mr. Faulkner, formerly connected with the Potomac Edison Co. at Williamsport, has been appointed chief engineer to take charge of its new power plant at Halltown.

THE HARTFORD ELECTRIC LIGHT CO. has work under way on an addition to its steam power plant at South Meadows, Conn. Stone & Webster, Inc., 49 Federal St., Boston, Mass., is engineer.

THE NARRAGANSETT ELECTRIC LIGHTING CO., Providence, R. I., has acquired about 224 acres of land in Bristol, R. I., with frontage on Narragansett Bay to be used for a new steam power plant of large capacity. The engineering department of the company will be in charge of the project.

THE PENNSYLVANIA WATER & POWER CO., Holtwood, Pa., affiliated with the Consolidated Gas, Electric Light & Power Co., Baltimore, Md., is reported to be planning a hydroelectric development on the Susquehanna River about 15 mi. from Holtwood.

Books and Catalogs

OVERHEAD SYSTEMS REFERENCE BOOK.—A complete treatise on overhead transmission and distribution of electricity. Size 8½ by 11 in., 592 pages, 668 illustrations. National Electric Light Association, New York. $7.50; to members of the Association, $5.00.

Complete coverage of a highly important phase of the electric light and power industry has been achieved by the Overhead Systems Committee of the Engineering Section of the National Electric Light Association with the publication of its handbook, the "Overhead Systems Reference Book."

More than a handbook, this work is so comprehensive as to require but slightly less than 600 quarto pages. It represents the combined effort of hundreds of engineers connected with electric light and power companies in all parts of the country. Pooling the results

of their work on the transportation of power, these engineers have cleared their information through the Overhead Systems Committee and this compilation is the result of their efforts.

Although it is, in a way, a successor to the "Handbook on Overhead Line Construction," last printed in 1914 and out of print for some years, the new book has been completely rewritten and rearranged. The principal subjects, aside from tables and general information, are in order, Wood Poles, Steel Poles, Towers and similar structures, Materials, Insulators, Transformers, Protective Apparatus, Street Lighting, Electrical and Mechanical Calculations, Methods of Construction, Meteorological Data and Suggested Specifications.

All of these subjects are presented in such a manner that they are directly applicable to modern conditions and they have, therefore, a freshness and practical usefulness that is often lacking when old material has been reworked. Through selection of the most desirable methods that are employed in this important work in various sections of the country it has been possible to present in tangible and readable form the most approved and satisfactory methods. Replete with illustrations, drawings and information, the work is the last word in present day construction and maintenance.

Appearing at this time, this textbook on overhead power lines assumes an added importance in view of the research work on power transportation started by the N. E. L. A. during the last year in various universities. Using the methods shown in this book as a basis the research engineers are further investigating the subject with the view of possibly improving on the practices that have so far been selected as the best.

Realizing the hard usage that is the lot of all engineering reference books, the paper and binding for the "Overhead Systems Reference Book" were selected with unusual care. The paper was made to specification and the binding was chosen for its durability.

CAPTAINS IN CONFLICT by Robert R. Updegraff. A business story of 285 pages, 6 by 9 in., cloth, Chicago, 1927, A. W. Shaw Co.

Here, in interesting story form, is found the history of the activity of promoters in formation of trusts and the fight which one courageous man waged against the plundering methods employed by some promoters. It is a story for men interested in business and gives a vivid word picture of the conflict of 20 yr. ago, which will be found pleasant reading by every business man. Emphasizing, as it does, the worth-whileness of sticking to the cardinal virtues in business transactions and putting service to the public foremost, as a business ideal, it also points a moral, without stating it, as to the proper fundamental policy for business success. For those who are looking for an acceptable present to give a business man, this book will furnish a solution of the gift problem which will be sure to give pleasure to the recipient.

HYDRAULIC POWER COMMITTEE of the National Electric Light Association, 29 W. 39th St., New York City, has recently issued a report entitled "Effect of Speed Regulation and Water Hammer on the Design of Relief Valves, Penstocks and Surge Tanks." This report reviews briefly the generally accepted formulas for speed regulation and the various theories of water hammer with their limitations and illustrates how both the factors affect and are affected by the design of the penstocks, relief valves and surge tanks in modern medium or high head hydro-electric developments.

FOREIGN DEVELOPMENTS is the title of a recent serial report of the Prime Movers Committee of the N. E. L. A., 29 W. 39th St., New York City. This describes briefly projects actually completed, contracted for or under way in foreign countries. Consideration is also given to trends and personal opinions of foreign engineers together with summaries of papers presented at the Sectional meeting of the World Power Conference at Basle and the Rome Congress of the Union Internationale d'Energie Electrique. An abstract of an address by Sir John Snell is included, also an abstract of the last chapter of a book by Prof. E. A. Kraft, chief of the turbine department of the A. E. G., in Berlin.

FOUR BOOKLETS are being distributed by the National Electric Light Association for the purpose of increasing use of power in homes. These have been prepared especially by the Women's committee of the association and are addressed to the woman of the household. The first, on Wiring the House shows how electricity saves labor and the importance of adequate wiring and outlets. The second, on Better Lighting, includes discussion of home lighting. The third, on Washing by Electricity, describes the different types of washers, shows how a laundry should be arranged and gives hints in regard to difficult washing jobs. The fourth, on Ironing, shows how to iron by hand, how to iron by power and the advantages of the latter. Copies of these pamphlets can be secured from the National Electric Light Association, 29 W. 39th St., for prices depending on the amount ordered.

NATIONAL LAMP WORKS OF GENERAL ELECTRIC CO., Nela Park, Cleveland, Ohio, has just issued two bulletins on lighting. One of these is entitled "Illumination Design Data for Industrial and Commercial Interiors" by Ward Harrison and C. E. Weitz. This is a handbook for lighting specialists, electrical contractors, engineers, etc. The other bulletin is entitled "Farm Lighting," by W. C. Brown.

DRY QUENCHING OF COKE by the Sulzer system is described in a circular issued by the Dry Quenching Equipment Corp., 200 Madison Ave., New York. Arrangement and construction of the plant are shown and data given as to conditions and cost of operation. This is the first publication issued to present this system of quenching to industries of the United States. Copies can be had on request.

PYRENE MFG. CO., 560 Belmont Ave., Newark, N. J., has just issued a bulletin announcing the Phomeme accumulator, designed to deliver automatically a supply of fire preventing foam to any point in which there is danger of fire from inflammable liquids. The equipment is controlled by a thermostatic device located at the point of hazard.

THE BROWN INSTRUMENT CO., Wayne & Roberts Avenues, Philadelphia, Pa., has just issued an illustrated booklet entitled "The Chief Engineer Sees the President," which illustrates by pictures a case in which the chief engineer shows the president why instruments are needed in his power plant and demonstrates how they prove a profitable investment.

RECORD OF WEAR of 100 Diesel Engines is the title of a finely printed and illustrated booklet issued by the Busch-Sulzer Bros. Diesel Engine Co. of St. Louis, giving the record of its engines as to cylinder head replacement, life of liners, piston replacement, piston pin, crank pin and main bearings wear. The engines run from 120 to 520 brake horsepower with total power of 26,245 br.hp. and have been in service one to 19 yr., the average being 6.85 yr.

Tabulated record of wear and replacements for each engine gives a comprehensive view of individual performance.

BULLETIN 827 of The Esterline-Angus Co. describes a recording unit for surface condensers which makes a record of vacuum, boiler priming and leakage of cooling water. The bulletin illustrates and describes the apparatus and shows records which are made by the device.

AMERICAN DISTRICT STEAM CO., North Tonawanda, N. Y., has just issued the first four numbers of Volume I of the Adsco Advocate, its new company magazine. These include a history of district heating, interesting features of the central plant of Syracuse University and the new high pressure steam line of the Utica Gas & Electric Co.

CORDUROY CRANES is the title given its bulletin 43-X by the Harnischfeger Corp. of Milwaukee, Wis. The bulletin describes the construction of these cranes, which are of boom type mounted on a caterpillar tractor base, and shows their application to all kinds of industrial uses as well as to storage and handling of coal and ash.

THE MCMYLER-INTERSTATE CO., Bedford, Ohio, has issued an illustrated booklet entitled, "A Trip Through One of Cleveland's Large Industrial Plants," containing mostly photographs of the shops in which McMyler-Interstate materials handling equipment is manufactured.

THE PYROMETER INSTRUMENT CO., 74 Reade St., New York City, has issued two bulletins describing recent development of the company. First of these is the Pyro electric tachometer designed to transmit its readings to a meter of the plain indicating or recording type. Second is a simplified Pyro optical pyrometer designed to get readings at a distance of 10 ft. of an object as small as ¼ in. in diameter.

LEAFLET 3907-C of the Westinghouse Electric and Manufacturing Co. describes turbines for mechanical drive in capacities 5 to 750 b.hp. They are well suited for driving circulating pumps, centrifugal boiler feed pumps, blowers and other rotary apparatus either directly or through the medium of reduction gears. The leaflet contains a number of illustrations together with descriptive information of the turbines.

THE D. O. JAMES MFG. CO., 1120 W. Monroe St., Chicago, has recently issued catalog No. 133, completely describing James generated continuous-tooth herringbone gears and speed reducers.

SULLIVAN MACHINERY CO., 122 S. Michigan Ave., Chicago, Ill., in bulletin 83-G describes and illustrates a new line of Sullivan high-pressure, angle-compound, gas and air compressors of the two-stage type suitable for pressures from 250 to 1000 lb. per sq. in.

A NUMBER OF NEW leaflets recently received from the General Electric Co., Schenectady, N. Y., have titles and numbers as follows: GEA-6A, Squirrel Cage Motors (500 Series); GEA-795, Air Compressor Governors; GEA-812, Air Heating Units; GEA-811, Jack Type Disconnecting Switches; GEA-808, New Form R Totally Enclosed Induction Motor (500 Series); GEA-787, Vertical (500 Series) Induction Motors; GEA-712, Type BTA Motors; GEA-246A, General Purpose Synchronous Motors (700 Series); GEA-98, Adjustable Varying Speed Motors; GEA-267, Motor Starting Switches; GEA-707A, Modernizing Mine Locomotives.

THE DETROIT STOKER CO., General Motors Bldg., Detroit, Mich., has just published a new bulletin No. 979, entitled "The Most Economical Method of Burning Coal." This discusses the factors to be considered in selecting fuel burning equipment and describes the various types of Detroit stokers.

IN AN ILLUSTRATED bulletin, No. 11, published by Edward T. Moore, 500 Cahill Bldg., Syracuse, New York, is described the Edmoore Power Demand Limitator, an electrical device for automatically controlling and limiting the power demands or peak loads on electric power systems for consumers.

WESTINGHOUSE ELECTRIC & MFG. CO., E. Pittsburgh, Pa., in a recent leaflet describes single phase, platform mounting transformers for voltages from 2300 to 66,000, ranging in capacity from 201 to 500 kv.a.

WM. W. NUGENT & CO., INC., 410-413 N. Hermitage Ave., Chicago, has just issued an illustrated 8-page bulletin on "How to Oil an Engine," by Wm. W. Nugent, president of the company.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., in bulletin No. 1236, recently issued, describes and illustrates Texrope drives for machine tools.

BULLETIN No. 30 of the Silent Hoist, Winch & Crane Co. describes its winches and their adaptation for use in factories and power plants for such work as crane operation, installation of machinery and erection of pole lines.

OHIO COMMITTEE ON PUBLIC UTILITY INFORMATION, Illuminating Bldg., Cleveland, Ohio, has issued the fourth edition of its text book entitled "Aladdins of Industry," compiled for use in schools and colleges of Ohio, containing surveys of the development of several major public services.

BOND STANDARD STOCK GEARS are described and illustrated in Catalog No. 52, issued by Charles Bond Co., 617 Arch St., Philadelphia, Pa.

BETHLEHEM STEEL CO., Bethlehem, Pa., in Catalog J, a 24-page illustrated bulletin just issued, describes Bethlehem pulverizers, showing details of operation and construction of this type of installation.

H. D. CONKEY & CO., Mendota, Ill., in a recent 44-page illustrated bulletin, No. 100, describes and illustrates Conco cranes and trolleys, giving dimensions, price lists and details of parts, with photographs of installations.

HAGAN CORP., Bowman Bldg., Pittsburgh, Pa., has issued a twenty-four page illustrated bulletin entitled "The Wet Steam Problem—How to Solve It," describing the details and operation of the Hagan steam purifier.

Sparks from the Advertising Pages

Where Buyers and Sellers Meet

Service on Display

No idea conceived in the brain of man has benefited the world until it has been known to the world. Hidden lights do not guide the feet of mankind.

Nor has any idea promulgated by one man remained long in its original state. Many minds and many hands must always join to bridge the gap between discovery and general application.

Invention is the foundation on which the combined brains and hands of scientific tests, skilled labor and judgment in selection finally build a useful service for us all.

Any worth while idea shared by one person with another stimulates both minds to produce something better. Rivalry follows as ideas are spread in an ever widening circle, pushing out the inefficient and improving the good.

No one can forecast the future. Yet all can take precautions for the future All can choose the best equipment, the best supplies available, and prepare themselves by study and test and practice!

Change and development are as inevitable as day and night.

At the Power Show, and in these pages, the machinery, equipment and supplies on display will each represent a service that has been given by many minds and many hands in testing and discarding and building over again until the highest type of service has been moulded into a tangible form.

Herein, and in the following December 1st Power Show Number, you will find, bound into print, as it were, presented for careful thought and prestudy, descriptions and illustrations of equipment, each piece of which has been created by time and the combined efforts of many men, tested and proved in the service of many power plants and ready to serve in your plant to further its reliability and economy of operation.

Your future, the future of the power plant field and the future of all this power-driven civilization of today, shall grow and flourish, or wither and die, in proportion as your judgment shall select the correct equipment for your plant and use vigilance and care in its operation.

It is service, not cold inanimate machinery alone, that is on display here in the advertising pages of this issue, at the exhibits at the New York Power Show and in the pages of the December 1st, New York Power Show Number, that immediately follows this number.

This service will be demonstrated whenever you permit the representatives of this or that piece of machinery to show its advantages.

Back of this service is an invisible but very real service, the service for years to come, the length and quality of which can be measured only by the reputation of the maker.

Established, reliable, progressive manufacturers are the only kind who can continuously advertise their products and show them before the engineering world.

Machinery, Equipment and Supplies Used In The Production and Transmission of Power

Under the heading of each product listed will be found the names of the manufacturers of that product. The index to advertisers, next to the back cover, gives the page numbers on which the manufacturers' descriptive advertisements appear.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Binks Spray Equip. Co., Chicago.
De Laval Steam Turbine Co., Trenton, N. J.
Gardner-Denver Co., The, Quincy, Ill.
Ingersoll-Rand Co., New York.
Murray Iron Works Co., Burlington, Iowa.
Sullivan Machy. Co., Chicago.
Worthington Pump & Mach. Corp., New York.
Yeomans Bros. Co., Chicago.

AIR COOLERS.
Spray Engineering Co., Boston.

AIR FILTERS
Connor Co., Inc., The W. B., N. Y.
Spray Engineering Co., Boston.

AIR PREHEATERS.
Air Preheater Corp., New York.
Babcock & Wilcox Co., N. Y.
Combustion Engrg. Corp., New York, N. Y.
Prat-Daniel Corp., New York.

AIR WASHERS
Buffalo Forge Co., Buffalo, N. Y.
Connor Co., Inc., The W. B., N. Y.
Spray Engineering Co., Boston.

ALARMS, HIGH AND LOW WATER
Hills-McCanna Co., Chicago.
Huyette Co., Inc., The Paul B., Philadelphia.
Northern Equipment Co., Erie.
Reliance Gauge Column Co., Cleveland.
Wright-Austin Co., Detroit.

ANTI-CORROSIVE COATINGS
Dampney Co. of Am., Boston.

ARCHES, BOILER AND COMBUSTION
Brady Conveyors Corp., Chicago.
Carborundum Co., Perth Amboy.
Denver Fire Clay Co., Denver.
Detrick Co., M. H., Chicago.
Girtanner Engrg. Corp., N. Y.
Green Fire Brick Co., A. P., Mexico, Mo.
Harbison-Walker Refract. Co., Pittsburgh, Pa.
Hofft Co., M. A., Indianapolis.
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., The S., Chicago.
Pilbrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refractories Co., Inc., Lock Haven, Pa.
Quigley Furnace Spec. Co., N. Y.

ASH BIN GATES AND DOORS
Allen-Sherman-Hoff Co., Phila.
Beaumont Co., R. H., Phila.
Frederick Iron & Steel Co., Frederick, Md.
Girtanner Engrg. Corp., N. Y.

ASH HANDLING SYSTEMS
Allen-Sherman-Hoff Co., Phila.
Beaumont Co., R. H., Phila.
Brady Conveyors Corp., Chicago.
Combustion Engrg. Corp., New York, N. Y.
Conveyors Corp. of Am., Chicago.
Detrick Co., M. H., Chicago.
Frederick Iron & Steel Co., Frederick, Md.
Girtanner Engrg. Corp., N. Y.
Link-Belt Company, Chicago.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., The, Chicago.

ASH TANKS
Brady Conveyors Corp., Chicago.

BABBITT METAL
Magnolia Metal Co., New York.

BEARING METAL
Magnolia Metal Co., New York.

BEARINGS
National Tube Co., Pittsburgh.

BELT CONVEYORS
Jeffrey Mfg. Co., Columbus.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., The, Chicago.

BELT DRESSING
Dixon Crucible Co., Jos., Jersey City, N. J.
Standard Oil Co. (Indiana), Chicago, Ill.
Stephenson Mfg. Co., Albany.

BELTING
Crandall Pkg., Palmyra, N. Y.
Quaker City Rubber Co., Phila.

BELTING, SILENT CHAIN
Link-Belt Co., Chicago, Ill.

BLOWERS, FAN & FURNACE
Air-Preheater Corp., New York.
Carling Turbine Blower Co., Worcester, Mass.
Coppus Engrg. Corp., Worcester.
De Laval Steam Turbine Co., Trenton, N. J.
Ingersoll-Rand Co., New York.
Prat-Daniel Corp., New York.
Terry Steam Turbine Co., Hartford, Conn.
Wing Mfg. Co., L. J., New York.

BLOWERS, FORCED DRAFT.
Sturtevant Co., B. F., Boston, Mass.

BLOWERS, PORTABLE.
Sturtevant Co., B. F., Boston, Mass.

BLOWERS, PORTABLE ELECTRIC.
Breuer Elec. Mfg. Co., Chicago.

BLOWERS, PRESSURE
Carling Turbine Blower Co., Worcester, Mass.

BLOWERS, PULVERIZED COAL
Buffalo Forge Co., Buffalo.

BLOWERS, STEAM
Schutte & Koerting Co., Phila.

BLOWERS, TUBE
Diamond Power Spec. Corp., Detroit, Mich.
Marion Mach., Fdry. & Supply Co., Marion, Ind.
Vulcan Soot Cleaner Co., Du Bois, Pa.

BLOWERS, TURBINE
Carling Turbine Blower Co., Worcester, Mass.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Wing Mfg. Co., L. J., New York.

BOILER BAFFLES
Boiler Engrg. Co., Newark, N. J.
McLeod & Henry Co., Troy, N. Y.
Quigley Furnace Spec. Co., N. Y.

BOILER CAP CLEANERS
Lagonda Mfg. Co., Springfield, O.

BOILER CASING
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

BOILER COATINGS
Dampney Co. of Am., Boston.

BOILER COMPOUND
Dearborn Chemical Co., Chicago.
Hawk-Eye Compound Co., Blue Island, Ill.
McLeod & Henry Co., Troy, N.Y.
Paige & Jones Chem. Co., Inc., New York.

BOILER COMPOUND FEEDERS
Hills-McCanna Co., Chicago, Ill.

BOILER ENGINEERS
Boiler Engrg. Co., Newark, N. J.

BOILER FEED WATER, PURIFYING APPARATUS
Griscom-Russell Co., New York.
Paige & Jones Chem. Co., Inc., New York.
Permutit Co., New York, N. Y.

BOILER FRONTS
McLeod & Henry Co., Troy, N.Y.

BOILER MOUNTINGS
Lunkenheimer Co., Cincinnati.

BOILER SETTING CEMENT
Botfield Refractories Co., Phila.
Carborundum Co., Perth Amboy.
Green Fire Brick Co., A. P., Mexico, Mo.
Harbison-Walker Refract. Co., Pittsburgh, Pa.
Huyette Co., Inc., The Paul B., Philadelphia.
Insulating Products Corp., N. Y.
Obermayer Co., The S., Chicago.
Pilbrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refract. Co., Inc., Lock Haven, Pa.
Quigley Furnace Spec. Co., N. Y.

BOILER SETTINGS
Botfield Refractories Co., Phila.
Carborundum Co., Perth Amboy.
Denver Fire Clay Co., Denver.
Green Fire Brick Co., A. P., Mexico, Mo.
Harbison-Walker Refract. Co., Pittsburgh, Pa.
McLeod & Henry Co., Troy, N.Y.
Obermayer Co., The S., Chicago.
Pilbrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refract. Co., Inc., Lock Haven, Pa.
Quigley Furnace Spec. Co., N. Y.
Rust Engrg. Co., Pittsburgh.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOILER TUBE CLEANERS
Lagonda Mfg. Co., Springfield, O.
Liberty Mfg. Co., Pittsburgh.
Pierce Co., Wm. B., Buffalo.
Roto Co., The, Hartford, Conn.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 182

BOILER TUBES
Babcock & Wilcox Tube Co., The, Beaver Falls, Pa.
Murray Iron Works Co., Burlington, Iowa.
National Tube Co., Pittsburgh.
Pittsburgh Steel Products Co., Pittsburgh.
Reading Iron Co., Reading, Pa.
Scully Steel & Iron Co., Chicago.

BOILER WALL COATINGS
Botfield Refractories Co., Phila.
Insulating Products Corp., N. Y.

BOILERS
Babcock & Wilcox Co., N. Y.
Badenhausen Corp., Cornwells Heights, Pa.
Casey-Hedges Co., The, Chattanooga, Tenn.
Combustion Engrg. Corp., New York, N. Y.
Connelly Boiler Co., The D., Cleveland, O.
Erie City Iron Works, Erie.
Heine Boiler Co., St. Louis, Mo.
Kingsford Fdry. & Mach. Wks., Oswego, N. Y.
Ladd Water Tube Boiler Co., Pittsburgh, Pa.
Murray Iron Works Co., Burlington, Iowa.
Springfield Boiler Co., Springfield, Ill.
Union Iron Wks., Erie, Pa.
Vilter Mfg. Co., Milwaukee.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Wickes Boiler Co., Saginaw.

BOILERS, HEATING
Edge Moor Iron Co., Edge Moor, Del.

BOILERS, WASTE HEAT
Edge Moor Iron Co., Edge Moor, Del.

BOILERS, WATER TUBE
Edge Moor Iron Co., Edge Moor.

BOOKS & SCHOOLS.
McGraw-Hill Book Co., N. Y.

BRICKS, FURNACE LINING
Norton Co., Worcester, Mass.

BREECHINGS
Connery & Co., Inc., Phila.
Heine Boiler Co., St. Louis, Mo.
Littleford Bros., Cincinnati
Prat-Daniel Corp., New York.

BRUSHES, DYNAMO AND MOTOR
Dixon Crucible Co., Jos., Jersey City, N. J.
LeValley Vitae Carbon Brush Co., New York, N. Y.

BRUSHES, GRAPHITE
Dixon Crucible Co., Jos., Jersey City, N. J.

BRUSHES, WIRE
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis, Mo.

BUCKET ELEVATORS
Brady Conveyors Corp., Chicago.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Company, Chicago.
Webster Mfg. Co., The, Chicago.

BUCKETS, COAL HANDLING
Jeffrey Mfg. Co., Columbus, O.

CAR DUMPERS
Wellman-Seaver-Morgan Co., The, Cleveland, Ohio.

CARRIERS, PIVOTED BUCKET
Jeffrey Mfg. Co., Columbus, O.
Webster Mfg. Co., The, Chicago.

CASTINGS
Erie City Iron Wks., Erie.
Fuller Lehigh Co., Fullerton, Pa.
Girtanner Engrg. Corp., N. Y.
Hills-McCanna Co., Chicago.
Neemes Fdry., Inc., Troy, N. Y.

CEMENT, FURNACE
Botfield Refractories Co., Phila.
Carborundum Co., Perth Amboy.
Denver Fire Clay Co., Denver.
Green Fire Brick Co., A. P., Mexico, Mo.
Harbison-Walker Refract. Co., Pittsburgh.
Insulating Products Corp., N. Y.
McLeod & Henry Co., Troy, N.Y.
Norton Co., Worcester, Mass.
Obermayer Co., The S., Chicago.
Pilbrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refract. Co., Inc., Lock Haven, Pa.
Quigley Furnace Spec. Co., Inc., N. Y.

CEMENT GUNS.
Cement Gun Co., Inc., Allentown, Pa.

CEMENT, HIGH TEMPERATURE
Botfield Refractories Co., Phila.
Denver Fire Clay Co., Denver.
Harbison-Walker Refract. Co., Pittsburgh, Pa.
Johns-Manville Corp., New York.
McLeod & Henry Co., Troy, N.Y.
Norton Co., Worcester, Mass.
Obermayer Co., The S., Chicago.
Pilbrico Jointless Firebrick Co., Chicago, Ill.
Quigley Furnace Spec. Co., N. Y.

CEMENT, INSULATING
Insulating Products Corp., N. Y.

CEMENT, IRON
Smooth-On Mfg. Co., Jersey City.

CHAIN WHEELS
Babbitt Steam Specialty Co., New Bedford, Mass.

CHAINS, DRIVE
Link-Belt Company, Chicago.

CHEMICALS, WATER TREATING.
Chicago Chemical Co., Chicago.
Permutit Co., New York.

CHIMNEYS
American Chimney Corp., N. Y.
Prat-Daniel Corp., New York.
Rust Engrg. Co., Pittsburgh.
Springfield Boiler Co., Springfield, Ill.

CIRCUIT BREAKERS
Cutter Co., The, Philadelphia.

CLEANERS, BOILER TUBE
Lagonda Mfg. Co., Springfield, O.
Liberty Mfg. Co., Pittsburgh.
Pierce Co., The Wm. B., Buffalo.
Roto Co., The, Newark, N. J.

CLEANING COMPOUND
Dearborn Chem. Co., Chicago.

COAL AND ASH-HANDLING MACHINERY
Allen-Sherman-Hoff Co., Phila.
Beaumont Co., R. H., Phila.
Brady Conveyors Corp., Chicago.
Detrick Co., M. H., Chicago.
Frederick Iron & Steel Co., Frederick, Md.
Jeffrey Mfg. Co., Columbus, O.